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Vol. 21 November 1954 No. 11

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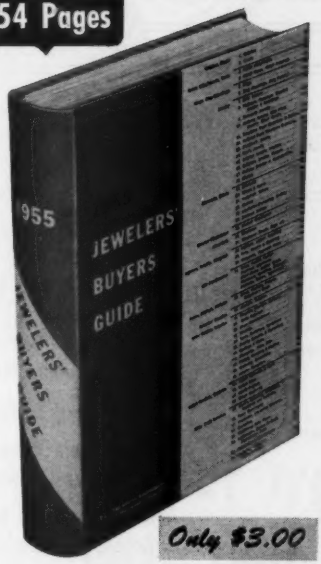

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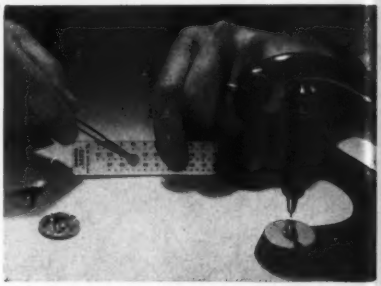

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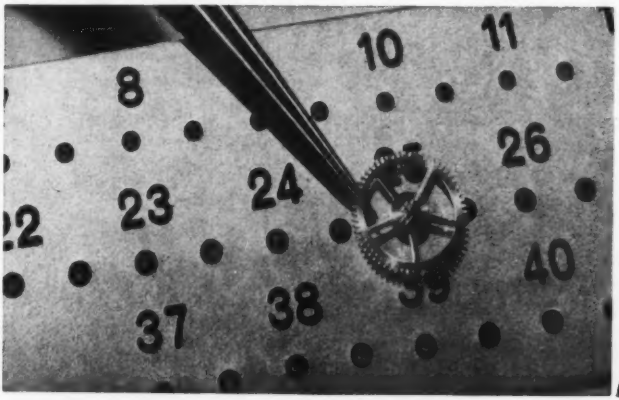

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#611H—6x11x10½
#611K—6x11x11½
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#610H—6x10x10½
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Volume 21 November, 1954 No. 11

How to Reduce Comebacks To a Minimum

Lecture 3
ASSEMBLING A WATCH

By DR. H. ATLANTIS SUDBURY

From a recent series of 13 lectures delivered before the Horological Assn. of California. (All rights reserved.)

THERE are many different ways to assemble a watch; some are good, some are not. It is not our intention to give you one person's opinion in these lectures, but the shortest, easiest and best methods employed by the finest workmen.

The watch repairman works on many different kinds of watches during the day; he, therefore, subconsciously sets up a common routine for repairing and cleaning the general run of watches.

After the parts are cleaned and arranged for assembly, we replace all jewels that have been removed. The hole jewels that have "end stones" are oiled through the hole. The cup of the jewel is partly filled with oil and capillary attraction is started by inserting the point of a very fine round broach into the hole. Once in a great while, we find the oil will not be drawn into the hole. This could be due to the cap jewel being tight against the hole jewel, or too far away, old dry oil may be still on the jewels, or the oil too heavy. Whatever the cause, it should be corrected.

It has been tried and proven that all balance wheels should be poised and the roller jewel tested for firmness when a watch is cleaned. If a watch is out of poise it *cannot* be regulated to keep *good* time, and will be returned as unsatisfactory —if the customer does not take it to another store.

Attach the balance assembly to the balance bridge. The quickest way to accomplish this is to turn the balance bridge upside down and the balance assembly in place upside down over it. If this is done on an anvil or something above the bench top, the stud screw can be turned in easily. The plate is put into the movement holder, and the balance assembly screwed into place. We are now able to true the hairspring, in both the round and the flat, and line up the roller jewel without interference from other wheels and bridges. The balance assembly is now removed and placed gently in a *clean* place. Remember, any lint or dirt picked up by the oily end of the pivot will cause trouble.

Our next step is to replace the mainspring. If the watch shows that it has been

worked on before, it is advisable to check the mainspring for width, strength, and length. With a suitable gauge, measure the inside depth of the barrel, in millimeters, and deduct ten hundredths (10/100) of a millimeter for side clearance. This will give you the correct width of the mainspring. There is no way to determine the exact strength of a mainspring, except by testing it in the watch. Some watches require stronger mainsprings than others; the number of jewels, the gears ratio, the finish of pivots, pinions, and teeth, all go to determine the strength of the mainspring. It also must be remembered that mainsprings vary in quality, temper, and finish. However, the following simple method will save you time and bring you very close to the exact thickness and length for nearly all Swiss and American wrist watches.

Measure the inside diameter of the mainspring barrel in millimeters and multiply this number by .0111 for the mainspring strength of the average Swiss watch; thus:

Diameter 8.5 × .0111 = .09435

The nearest mainspring strength would be .095 mm.

Now as there are 25.4 millimeters to one inch, we can multiply this same diameter by 1.25 and get the length of the mainspring in inches; thus:

8.5 × 1.25 = 10.625 inches

The nearest mainspring length to this would be 10½ inches.

From this, we can readily see that if we add one (1) to the inside diameter of any Swiss mainspring barrel between 8 mm. and 12 mm., we will have the approximate strength of the desired mainspring; also, if we add one (1) more, we will have the length in inches.

You will save time and money by throwing away a magnetized mainspring. The average watch repairer cannot completely demagnetize one. If he could, the time spent would cost more than a new spring. The present day demagnetizers are not strong enough, and heat up too quickly. If a magnetized mainspring is put back into a watch, it will cause trouble hard to locate. As the coil unwinds it changes its polarity, due to the turns changing their positions, causing a strong magnetic attraction at certain points as they move slowly around.

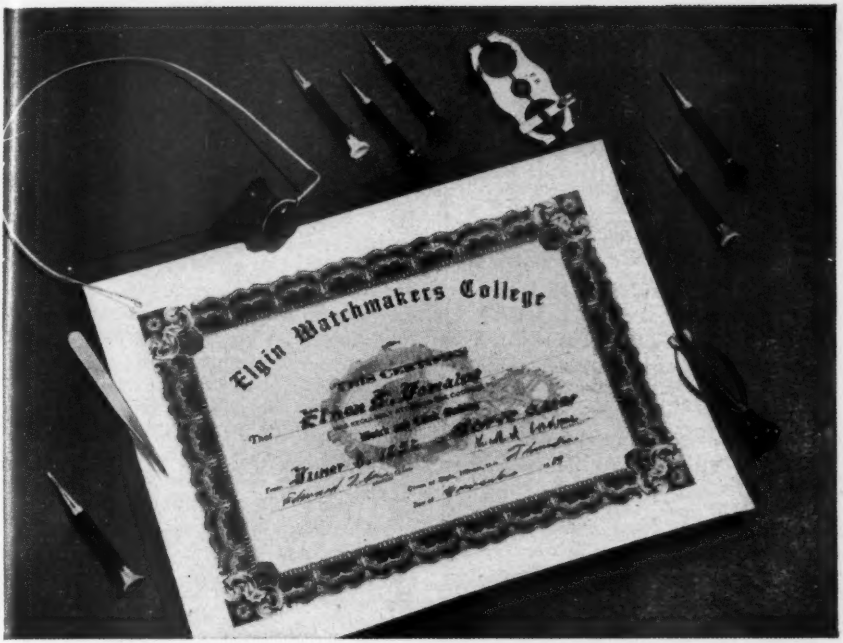
What is the best lubricant to use on a mainspring? From an observation barrel, we have learned that light oil will not let a mainspring slide down evenly; not enough oil stays between the layers of the spring to assure a smooth action. Furthermore, there is danger of light oil seeping out to the center wheel and being carried around to the hairspring. Vaseline and petrolatum are not much better. Graphite mixed with grease is good, but it is dirty to handle, and not wanted on the bench. A long-fiber, gear or chassis grease with high viscosity seems to do the trick nicely. A small amount rubbed on watch paper and gently drawn along both sides of the spring will be sufficient.

Do not take a chance of distorting the mainspring by twisting it into the barrel by hand; always use a mainspring winder.

The lubrication of the remaining parts of the watch is even more important than that of the mainspring. After keeping records for a number of years, and carefully checking the watches as they came back for repair and cleaning, we are convinced that any oil that becomes rancid and actually "stinks" at the end of a year, is not the right oil to use in a watch. Any oil that gets gummy and has to be scraped off the jewels at the end of twelve months may be all right for a wheelbarrow, but not for a watch. You can go to the drug store and buy better oil for less money than some of the watch oils on the market today. It's going to be hard to convince me that an oil made of dead animals or rotten vegetables is better than mineral oil for any machine, regardless of size. Get a good refined mineral oil that will suit your particular need, and you will be quite safe in using it.

You should also remember that if you live in a state that is very cold in the winter and hot in the summer, it may be necessary for you to try several oils, keeping careful records, until you find the one that suits your particular purpose best.

Here are a few simple tests which you can make. Take a piece of glass, about the size of a lady's pocket mirror and place on it, in a row, a small drop of oil from several different brands. Each drop must be



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exactly the same size. Stand the glass on edge for a day, and see which oil stays closest to the place where you put it. If none of the oils run, increase them all in size being careful not to get the oils mixed. Make a careful record of each brand.

For the second test, repeat the operation. But this time, instead of placing the glass on edge, put it in the hot sun, or an evenly warmed place for several days. When you think some one of the oils has dried up, test them all with a strong loupe and a fine tool, like a small screwdriver, or a toothpick.

For the third test, put a small amount of oil in separate small bottles, cork tightly and leave them in hot sun for a week. Then smell them each day until you can decide whether or not any has become rancid. Grade them accordingly. From this record you can tell if you have an oil that has a tendency to stay put, will not dry up, and does not turn rancid. If you have none of these, try other oils.

With the present day watches, it is hardly necessary for us to worry about oil running out of the pivot holes. If we put that much oil on the jewel, we have done a very poor job of oiling. There are very few who can oil a watch correctly. Sometimes I think there are none. Never put more oil on a jewel than enough to fill the hole; even that is too much. It has taken years for me to learn that too much oil is worse than none at all.

Use an oiler made of fine gold wire, split up the end about a half-inch and sharpened. Oil all the jewels in the plate except the pallet jewel. This will be explained in our next lecture.

* * *

(Next month, Lecture No. 4—Assembling a Watch—Continued).

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The Fast Beat System

OMEGA

From time to time there are requests from distributors and owners of Omega watches to explain the advantages of the Omega fast beat system.

As you know, the fast beat system is not a recent development. It has long been known that when the oscillation of the balance wheel is increased, the tendency of the movement to be interrupted and impaired by external disturbances is lessened. Therefore, when pocket watches and similar "protected" timepieces were in great vogue, the normal beat was deemed sufficient for maintaining accuracy.

Since the rise in popularity of the wrist watch, and the perfection of relatively dust-proof cases, the fast beat system has come to be recognized as the perfect antidote for the many different swings, turns, and positions of the wrist. However, the fast beat movement has to be absolutely clean, as the least speck of dust can impede the finely toothed gears.

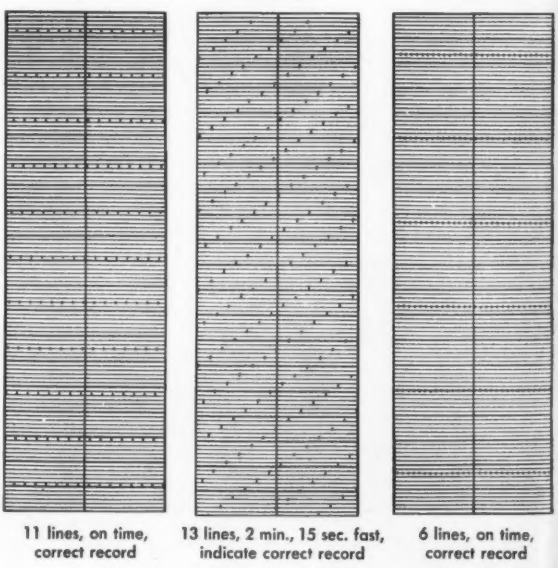
The watchmaker, of course, should be thoroughly acquainted with this type of movement. At the present time, Omega manufactures five models which employ the fast beat system—the 11.5 mm. the 13.5 mm, the 17.8 mm., the 28.10 mm. and the 30.10 mm.

The 11.5 mm., which is the smallest lady's watch we produce, is so constructed that it has 21,306 and 6/49 beats per hour. On the Watch-Master, it will record 13 lines on a two-minute and fifteen-second fast graph. Both the 13.5 mm. and the 17.8 mm. have 21,600 beats per hour and the graph recording is 6 lines straight across when these models are in perfect condition and correctly timed. Our automatic self-winding watches, the 28.10 and 30.10 mm., make 19,800 beats per hour and when in perfect condition record 11 straight lines across the drum.

We might call your attention to some of the newer models which are equipped with a two-piece regulator. Several of our distributors, called upon to service these watches, discovered that a line was either gained or lost on the recording when apparently there was nothing radically wrong with the watch itself.

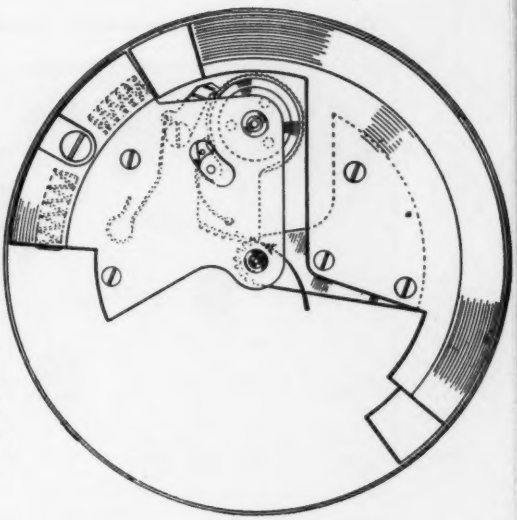
While, like all new creations, these watches must be more or less tried and tested before we can give any definite information on their action, we have found that, for some reason or other, the regulator is often pushed over to the extreme fast side or extreme slow side. This is especially true in our 28.10 movement. With a fast beat system it is very easy to get a very distorted graph which shows a gain or loss of a line. Should you experience this difficulty, we suggest that you make an initial recording to determine whether a line is lost or gained. If your regulator is over to the slow position, your watch will record 12 lines. If it is in the fast position, it will record 10 lines. A simple adjustment will then often correct the movement of the watch.

Should any other difficulties in the servicing of the fast beat movement occur, please feel free to contact the Omega service department in New York. A simple telephone conversation can often correct the difficulty.

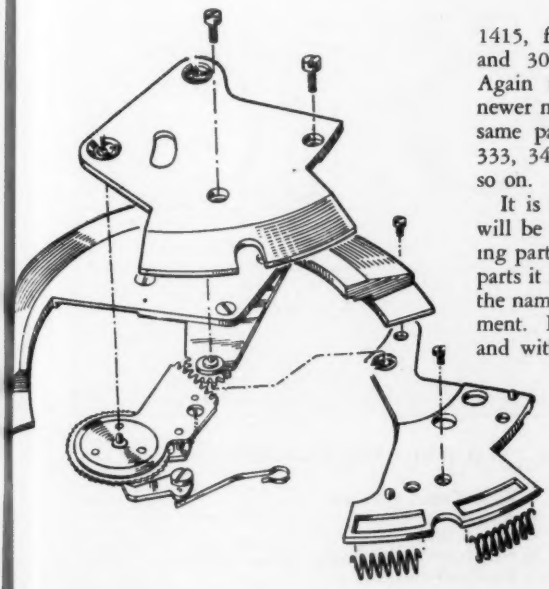


PARTS DATA ON OMEGA SEAMASTER CALENDAR WATCH

Interchangeability of Spare Parts Between Automatic Movements



When a new caliber such as the *Omega Seamaster Calendar* is developed for the world market, many unknown new parts become of interest to the watch repairer. With the thought in mind of helping watchmakers, Omega illustrates here a complete detail of all the parts of its Automatic Calendar movement, caliber No. 353. Most of these parts, with their numbers, are identical to those used in other Omega Automatic movements. For example: winding stem No. 1106 (indicated by symbol X) is the same for all Omega Automatics. The bumper springs, No. 1415, for movements 28.10, 28.10 S.C. and 30.10 (symbol □), are the same. Again the bumper spring used in the newer movement 351 is identical with this same part used in movements 332, 342, 333, 343, 352 and 353 (symbol X) and so on.



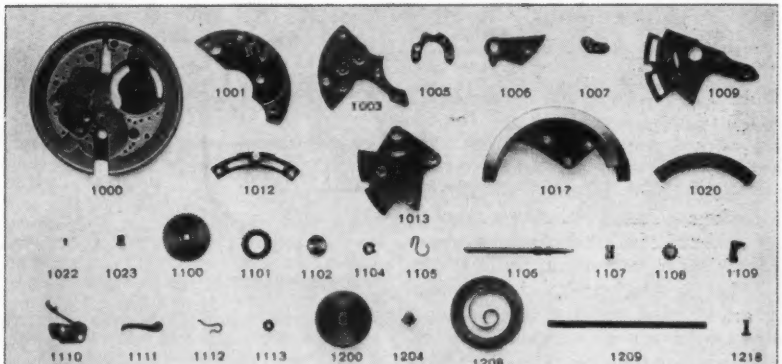
It is felt that this cross reference chart will be of considerable assistance in keeping parts stock in order. When requesting parts it is most important to specify clearly the name of the part and the proper movement. In this way service will be quick and without error.

Omega Seamaster Automatic - Calendar Model

Caliber 353

(28.10 TI. RA. SC. PC. AM.)

Calendar, 17 Jewels, Automatic, Sweep Second, Shockproof, Antimagnetic



ABBREVIATIONS USED FOR OMEGA CALIBERS:

TI = First Transformation
RA = Automatic Wind
SC = Sweep Second
PC = Shockproof (Incabloc)
AM = Antimagnetic

LIST OF INTERCHANGEABLE PARTS FOR OMEGA AUTOMATICS

Available from your local Material Distributor

No.	DESCRIPTION	28.10	28.10SC	30.10	332	342	351	333	343	352	353
1000	Jewelled Plate										
1001	Barrel Bridge	×		×							
1003	Jewelled Train-Wheel Bridge	–	×	–	□	□	×	C	C		×
1005	Jewelled Pallet Bridge	×	×	×	×	×	×	×	×	×	×
1006	Balance Cock (Balance Bridge)	×	×	×	×	×	×	C	C	C	×
1007	Jewelled Sweep Second Bridge						×			×	×
1009	Jewelled Intermediate Bridge						×				×
1012	Buffer Plate	□		□		–	×	□	–	×	×
1013	Jewelled Centre Bridge	□		□	□		×				×
1017	Oscillating Weight						×				×
1020	Segment for Oscillating Weight						×				×
1022	Fixation Pin	×	×	×	×	×	×	×	×	×	×
1023	Casing Tube				□	×	×	×	×	×	×
1100	Ratchet Wheel	×	×	×	×	×	×	C	C	C	×
1101	Crown Wheel	×	×	×	×	×	×	C	C	C	×
1102	Crown Wheel Core (Crown Wheel Cap)	×	×	×	×	×	×	C	C	C	×
1104	Click	×	×	×	×	×	×	C	C	C	×
1105	Click Spring	×	×	×	×	×	×	×	×	×	×
1106	Winding Stem	×	×	×	×	×	×	×	×	×	×
1107	(Clutch Wheel)	×	×	×	×	×	×	×	×	×	×
1108	Winding Clutch (Winding Pinion)	×	×	×	×	×	×	×	×	×	×
1109	Setting Lever (Detent)	×	×	×	×	×	×	×	×	×	×
1110	Setting Lever Bridge	×	×	×	×	×	×	×	×	×	×
1111	Yoke	×	×	×	×	×	×	×	×	×	×
1112	Yoke Spring	×	×	×	×	×	×	×	×	×	×
1113	Setting Wheel	×	×	×	×	×	×	×	×	×	×
1200	Barrel with Cover and Arbor	×	×	×	×	×	×	×	×	×	×
1204	Barrel Arbor	×	×	×	×	×	×	×	×	×	×
1208	Mainspring	□	×	□	□	□	×	□	□	×	×
1209	Mainspring Slipping Device	×	×	×	×	×	×	×	×	×	×
1218	Cannon Pinion	–	–	–	□	□	×	□	□	×	
1230	Centre Wheel with Cannon Pinion	–	–	–	□	□	×	□	□	×	
1240	Third Wheel	□	×	□	□	□	×	□	□	×	×
1243	Fourth Wheel	□	×	□	□	□	×	□	□	×	×
1246	Minute Wheel	×	×	×	×	×	×	×	×	×	×
1249	Wheel over Third Wheel (Sweep Second Wheel)		×				×			×	×
1250	Sweep Second Pinion (Center Pinion)						×			×	
1254	Bushing for Centre Wheel Pinion		×				×			×	
1255	Friction Spring for Sweep Second Pinion		×				×			×	×
1305	Escape Wheel	×	×	×	×	×	×	×	×	×	×
1312	Pallet Arbor	×	×	×	×	×	×	×	×	×	×
1313	Pallet Jewel (Out)	×	×	×	×	×	×	×	×	×	×
1314	Pallet Jewel (In)	×	×	×	×	×	×	×	×	×	×
1316	Lever Pallet Complete	×	×	×	×	×	×	×	×	×	×
1317	Hairspring Stud	×	×	×	×	×	×	×	×	×	×
1318	Hairspring Collet	×	×	×	×	×	×	×	×	×	×
1320	Complete Vibrated Hairspring	×	×	×	×	×	×	×	×	×	×
1321	Balance Staff	×	×	×	×	×	×	×	×	×	×
1322	Roller Pin	×	×	×	×	×	×	×	×	×	×
1324	Roller	×	×	×	×	×	×	×	×	×	×
1325	Balance Wheel Only	×	×	×	×	×	×	×	×	×	×
1326	Balance Wheel with Staff and Roller	×	×	×	×	×	×	×	×	×	×
1327	Balance Complete	×	×	×	×	×	×	×	×	×	×
1333	Two Piece Regulator	□	□	□	×	×	×	C	C	C	×
1341	Jewelled Setting, Incabloc, Upper and Lower	×	×	×	×	×	×	×	×	×	×
1342	Incabloc Endstone, Lower	×	×	×	×	×	×	×	×	×	×
1342	Incabloc Endstone, Upper	×	×	×	×	×	×	×	×	×	×
1344	Jewel Spring, Incabloc	×	×	×	×	×	×	×	×	×	×
1345	Incabloc Bridge Retaining Spring	×	×	×	×	×	×	×	×	×	×
1346	Complete Block, Incabloc, Lower	×	×	×	×	×	×	×	×	×	×
1347	Complete Block, Incabloc, Upper	□	□	□	×	×	×	C	C	C	×
1400	Staff for Centre Rack	×	×	×	×	×	×	×	×	×	×
1403	Centre Rack Complete with Staff	□	□	□	×	×	×	×	×	×	×
1405	Large Rack Washer	×	×	×	×	×	×	×	×	×	×
1407	Large Rack Complete with Stud and Impulse Click Spring	×	×	×	×	×	×	×	×	×	×
1410	Intermediate Wheel for Large Rack (Automatic Winding Wheel)	□	×	□	□	□	×	□	□	×	×
1411	Impulse Click Spring with Stud	×	×	×	×	×	×	×	×	×	×
1412	Impulse Click	×	×	×	×	×	×	×	×	×	×
1413	Locking Click Spring	×	×	×	×	×	×	×	×	×	×
1414	Locking Click	×	×	×	×	×	×	×	×	×	×
1415	Bumper Spring (Buffer Spring)	□	□	□	×	×	×	×	×	×	×
1416	Bushing for Intermediate Wheel, Upper and Lower	×	×	×	×	×	×	×	×	×	×
1500	Date Dial										
1501	Support Ring										

(Continued next page)

List of Interchangeable Parts for Omega Automatics - (continued)

No.	DESCRIPTION	28 10	28 10SC	30 10	332	342	351	333	343	352	353
1502	Attachment Ring										
1503	Date Jumper										
1506	Core for Calendar Intermediate Wheel										
1508	Hour Wheel (Double Toothing for Calendar)	-		-							
1509	Calendar Intermediate Wheel				□	□	×	□	□	×	
2003	Bridge and Cock Screw	×	×	×	×	×	×	C	C	C	×
2110	Pallet Bridge Screw	×	-	×	×	×	×	×	×	×	×
2166	Sweep Second Bridge Screw		×				×			×	×
2115	Ratchet Wheel Screw	×	×	×	×	×	×	C	C	C	×
2107	Setting Lever Screw	×	×	×	×	×	×	×	×	×	×
2109	Crown Wheel Washer Screw	×	×	×	×	×	×	C	C	C	×
2108	Click Screw	×	×	×	×	×	×	C	C	C	×
2606	Setting Lever Bridge Screw	×	×	×	×	×	×	×	×	×	×
2138	Lower Incabloc Plate Screw	×	×	×	×	×	×	×	×	×	×
2154	Stud Screw	×	×	×	×	×	×	×	×	×	×
2701	Dial Screw	×	×	×	×	×	×	×	×	×	×
2915	Balance Screw	×	×	×	×	×	×	×	×	×	×
2608	Friction Spring Screw		×				×			×	×
2016	Upper Centre Bridge Screw	□	×	□	□	□	×	C	C		×
2016	Intermediate Bridge Screw	-	×	-	□	□	×	□	□		×
2142	Bumper Spring Screw										
2609	Large Rack Washer Screw	×	×	×	×	×	×	×	×	×	×
2800	Impulse Click Screw	×	×	×	×	×	×	×	×	×	×
2801	Locking Click Screw	×	×	×	×	×	×	×	×	×	×
2805	Locking Click Spring Screw						×			×	×
2189	Centre Rack Screw				×	□	×	×	□	×	×
2145	Fixation Spring Screw—Fixation Clamp Screw	□	□	□	×	×	×	×	×	×	×
2614	Support Ring Screw										
2246	Attachment Ring Screw										
2614	Date Jumper Screw										
2213	Calendar Intermediate Wheel Core Screw										
2503	Enlarging Ring Screw										
2165	Ring Screw	×	×	×	×	×	×	×	×	×	×
4009	Upper Centre Bridge Jewel	×	×	×	×	×	×	×	×	×	×
4010	Lower Centre Bridge Jewel	×	×	×	×	×	×	×	×	×	×
4217	Upper Jewel for Third Wheel	□	×	□	□	□	×	□	□	×	×
4213	Lower Jewel for Third Wheel	×	×	×	×	×	×	×	×	×	×
4212	Upper Jewel for Fourth Wheel	×	×	×	×	×	×	×	×	×	×
4213	Lower Jewel for Fourth Wheel	□	×	□	□	□	×	□	□	×	×
4215	Upper Jewel for Escape Wheel	×	×	×	×	×	×	×	×	×	×
4208	Lower Jewel for Escape Wheel	×	×	×	×	×	×	×	×	×	×
4209	Upper Jewel for Pallet Arbor	×	×	×	×	×	×	×	×	×	×
4208	Lower Jewel for Pallet Arbor	×	×	×	×	×	×	×	×	×	×
1910	Fixation Spring	□		□	×	×	×	×	×	×	×
1911	Fixation Clamp				×	×	×	×	×	×	×
1941	Tube for Waterproof Case				×	×	×	×	×	×	×
1905	Enlarging Ring	×	×	×	×	×	×	×	×		
1910	Fixation Spring										
1961	Fixation Pin for Enlarging Ring				×	×	×	×	×	×	×

Available from your local Material Distributor

ATTENTION, WATCHMAKERS: Free Omega Technical Bulletins

The Norman M. Morris Corporation, U. S. distributor of Omega watches, has offered to furnish free on request to bona fide watchmakers a helpful series of Technical Bulletins, enclosed in an attractive loose-leaf binder. This practical gift is subject to the following conditions:

1. **In writing for the Bulletins, do not use post cards—make your request on your letterhead or store stationery.**
2. **Mention this free offer in the November issue of the American Horologist & Jeweler.**
3. **Address your request to the Technical Department, Omega Watches, 655 Madison Avenue, New York 21, N. Y.**

RWE: I am having more or less trouble setting roller jewels. More often than not, they fall out, and I would appreciate some suggestions on how to set a roller jewel.

Answer: Resetting or fitting a new roller jewel is a test of skill for all of us, especially when it comes to fitting a roller jewel for some of the very small watches on the market today. Your writer wishes he could tell the best way, but the best way is the one you find easiest to perform the job.

You will find jewel pin-setting tools listed in your jobbers' catalogues, made by the manufacturers with all intentions to be a useful tool, but when it comes to using some of the tools, we find they are too crude for the work we expected to use them for. Your writer can only suggest a few ways to set a roller jewel and it will be up to you to try them out, using the method you find the least troublesome.

Many workmen lose time trying to tighten a loose roller jewel. If it had been properly set the first time it would not have become loose. When you must tighten a roller jewel, bear in mind that the roller jewel was not clean and probably had an oily surface by some means or other, and that when setting a jewel having an oily surface the cement merely forms itself to the jewel but does not adhere, and will only hold temporarily. The roller table and jewel should be cleaned in alcohol so the surfaces are perfectly dry. When cement is applied it will flow around the jewel and adhere to the roller table as well. Then again, even if these precautions are taken, there is danger of overheating the cement, causing it to become dry and brittle and will crumble so that a jar will loosen the jewel, causing it to fall out.

Some workmen use special tweezers with a small groove on the inside of both points that will hold the jewel while placing it in the roller table. Another workman suggests an easy way to pick up a small roller jewel is to lay the jewel with the flat side up, and when all preparations are ready, set the jewel in the roller. Wet the tip of a screwdriver with your tongue and then contact the end of the roller jewel. Then it can be readily picked up and transferred to the roller table.

In summing up the whole job, it is one that takes care for cleanliness, and one that takes practice, to acquire the skill to set a roller jewel with the least lost motion and time.

HJC: I recently took in a repair job that interested me. Can I impose on you for information about the watch? It is marked "New England Watch Company,

INFORMATION PLEASE

Directed by
W. H. SAMELIUS

Chairman, Science of Horology and Technical Advisory Board

Waterbury, Connecticut" it is quite small —about ten lignes. It is open face and has a solid gold case. The movement is stamped "Elfs."

Answer: Looking through some 1909 circulars, I find the watch advertised. It has a duplex escapement, gilt movement, push button set, and sold to the retailer for $11.15 less 6 per cent. They also made a pocket watch for men, a 12-s nickel case, open face, that sold for $1.45 less 6 per cent. This was named "Hales."

JJB: Since taking up watchmaking I am becoming deeply interested in the construction of the watch and would like to know something about gearing and gear ratios. For instance, if I should be unfortunate enough to lose a wheel and pinion, how does one calculate for the number of teeth and leaves in the missing pinion? I know that many of your readers will say that wheels and pinions are obtainable for all watches today—which may be true for the modern watches, but we do run across old-timers and discontinued watches where no material is available, and it is for this reason I would like a formula or method for calculating the replacement of a wheel and pinion.

Answer: We must first learn how many beats per hour the balance makes. Practically all modern lever watches beat 18,000 vibrations an hour, but if the watch is of a model with which you are unfamiliar, hence in doubt as to its number of vibrations, you had better set the balance in motion and count the beats during a minute timed from another watch or clock which is known to keep good time. It is better to do this twice so as to be sure that your count is correct. Multiply this number of beats by 60 in order to get the number of vibrations per hour. Let us take for example 18,000 beats per hour. The center wheel must make one revolution while the balance beats 18,000 times, because to the center wheel's arbor is attached the minute hand, which must make one turn around the dial in one hour (the time of 18,000 beats). This condition will be fulfilled when the numbers of teeth of wheels multiplied together will equal 18,000 times the number of leaves of pinions multiplied together. In other words, the product of wheels divided by the product of pinions will equal the number 18,000. Another way of expressing the same idea is to write down the numbers in the form of an equation. Let us take the wheels and pinions of a complete train and count the teeth and leaves. We will assume that we have found that the numbers are as follows:

Center wheel	80
Third wheel	75
Third pinion	10
Fourth wheel	70
Fourth pinion	10
Escape wheel	15
Escape pinion	7

We can now set down our statement thus:

$$18{,}000 = \frac{80 \times 75 \times 70 \times 15 \times 2}{10 \times 10 \times 7}$$

and the equation can easily be proven by cancellation, or by carrying out the multiplications above and below the line and dividing the upper product by the lower; the 2 is included with the numbers above the line because each of the escape wheel teeth produces two beats, since it has to pass two pallets.

Now to find the numbers for a wheel or pinion, all that is needed is to count the teeth and leaves in the remaining members of the train and set them down as above, but in place of the lost member, put down a letter to represent it. Let us say that the center wheel is lost and we will use x to represent it:

$$18{,}000 = \frac{X \times 75 \times 70 \times 15 \times 2}{10 \times 10 \times 7}$$

cancelling, or multiplying and dividing, we find that

$$18{,}000 = 225 \times$$
$$\times = 80$$

The new center wheel therefore must have 80 teeth. Now suppose a wheel and pinion are both lost, the third wheel and pinion, for instance. Proceed in the same way to set down the known numbers and in place of the unknown ones put letters, thus:

$$18{,}000 = \frac{80 \times X \times 70 \times 15 \times 2}{y \times 10 \times 7}$$

Perform the operations indicated and you will find that

$$18{,}000 = 2400 \times \frac{}{y}$$

$$\frac{18{,}000}{2400} = \frac{x}{y}$$

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WATCHWORD OF THE WATCHMAKER
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Now reduce the fraction to its lowest terms by cancellation and you will have

$$\frac{15}{2} = \frac{x}{y}$$

Multiply both terms of the fraction by the same number; the result will be the number of teeth the wheel and leaves the pinion must have. The number used to multiply the fraction by could be any one at all, just so the same number is used on both terms of the fraction; but we will select one which will give 10 leaves to the pinion, as that will allow of a good shape for the leaves; multiplying both terms of the fraction by 5 gives us

$$\frac{75}{10} = \frac{X}{Y}$$

So the wheel must have 75 teeth and the pinion 10 leaves. Sometimes the operation will yield directly the numbers desired; it is usual to have the train so that there is a gradual lessening in the numbers from the center wheel to escapement and to avoid high or low numbers in the pinion.

ELMcR: I have been a constant reader of "Information Please" for a number of years, but as yet I have not read an answer to a question which frequently arises in my mind. I particularly refer to a situation which sometimes occurs when I am testing the action of the lever. I find that without the balance in position and the mainspring power off, I am able to set the lever in fast motion by exerting moderate pressure on the center wheel. This action never occurs under the normal power of the mainspring. What condition exists that permits such free action on the part of the lever?

Answer: There may be several reasons to cause the conditions you speak of. It could be excessive side shake in the pallet pivots, allowing the escape wheel to drop lock on the impulse face rather than the locking face. It could also be that the escapement is set up with a very light drop lock and slide, so that when the lever strikes the banking screws there will be a rebound of the lever sufficient to unlock the escapement, allowing the lever to pass to the opposite banking screw where the same action occurs.

This condition can happen if the lever is light and springy, or the banking pins may be light and springy, acting like a cushion, allowing the lever to rebound from the initial blow, but when the balance is placed in the watch the lever does not travel from bank to bank fast enough, causing a rebound.

HMcD: I am having trouble staking staffs to balances. More often than not, the balance is out-of-round and flat, and it takes a lot of time to true and poise a balance. Can you suggest what I am doing wrong? Any help will be appreciated. I am a beginner and find I have a lot to learn.

Answer: When staking a balance to a new staff, don't give one stroke of the hammer more than is needed to insure that the wheel is absolutely tight. Yes, it is a waste of effort, but that is not the real point. The more hammering you do, the more likely it is that the balance will be untrue, not only in the flat but in the round on the staff. If it is a ready-made staff you are fitting, first take time enough to select one that really fits. Under gentle pressure of a hollow punch, the balance should go home to its seat upon the staff. Then there is no side play and the balance and staff are true, and there should be no difficulty in staking the one truly onto the other.

See that the riveting extends only a very little above the arm of the balance when the latter is pressed right home. Otherwise, you may have difficulty in getting the balance tight.

A blow or two with a flat-faced hollow punch will usually do the rest. A single short sharp blow will do it, and leave an almost invisible riveting; then everything, including the punch, is just as it ought to be.

GE: Will you give a chart showing the value of colors on steel when tempering tools, and suitable colors for the different tools? Do you advise using a lubricant when turning or drilling steel or brass?

Answer: After the steel has been hardened and the surface cleaned ready for tempering, reheat the steel slowly until the following color appears: (Temp. F.)

Light Straw—For turning all metals, 430°.

Dark Straw—For wood tools, taps, dies, 470°.

Brown-Yellow—For hatchets, chipping

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No. 645B contains one of 144 different, high quality winding stems for bracelet and strap watches ranging from 3¼ to 13 ligne is contained in this unit.
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Supplement the above 645B Newall system with the No. 645C unit. The 144 additional numbers in this unit will add approximately 450 models in coverage, including automatics, calendars, and direct sweep second.
No. 645C.....$23.00 Each
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NEWALL MFG. CO.
ILLINOIS

tools, and percussion tools, 500°.

Dark Purple—Heavy springs, very little flexation, 530°.

Dark Blue and Medium Blue — Small springs, considerable flexation, 540°.

When cutting tool steel, you may use oil or cut dry. For drilling and tapping tool steel, use oil. For soft steel and heavy cuts, use soda water. For drilling and tapping soft steel, use oil or soda water. When turning brass, cut dry. For drilling brass, dry. For tapping, use oil. Copper, cut dry. For drilling and tapping, use oil. For cast iron, turn dry, drill dry, and oil for tapping. For glass, when drilling, use turpentine or kerosene.

SPE: What do you think about friction jewelling replacing the old method of burnishing jewels in the setting?

Answer: The old method of setting jewels in the mountings in the plate, polishing in the mountings and setting the mounting in the plate, polishing the mountings and countersinking the jewel screws made a very pleasing looking job, but it entailed a lot of work and time. Today when production and speed is a factor, frictioning jewels saves a lot of time, and accurate machinery that can punch and shave the hole to accurate size and accurate position means a lot of time saved.

Then with our modern methods and machines for producing jewels, almost 100 per cent accurate in size, it is an easy matter to press these jewels into the plate, producing a watch or a train of gears that is accurate, and perhaps more accurate than when the jewels were set in the mountings and the mounting set in the plate. Then there were several chances that the jewel might be eccentric or the mounting eccentric, or possibly the hole in the plate being out of upright. So today, if our modern watch with the friction jewels is a perfect timepiece, but perhaps not so attractive as the old timepiece having polished settings and screws, it is a lot easier to construct and maintain.

This makes it much easier for the watchmaker to replace any damaged jewel, as some very fine friction jewelling tools may be had, and an assortment of friction

jewels.

EGF: How is a fly cutter used when cutting wheels and pinions? I am thinking of building a clock, as I acquired a lathe complete with slide rest, milling head, and a full set of indexes, but somehow all the cutters are missing.

Answer: The fly cutter or single cutter is set into the arbor crosswise and held by a set screw running lengthwise to the axis of the arbor. When cutting a wheel using a fly cutter, it is advisable to go around once with a roughing-out cutter to remove most of the material from the spaces between the teeth and then make a finishing cut in each space with a fly cutter which has been shaped to cut exactly the outline desired for the tooth. The roughing-out cutter may be either a saw or milling cutter with multiple teeth, or it may be a fly cutter, single tooth. Either way will remove most of the metal, leaving just enough stock for the finishing fly cutter to work upon.

Fly cutters are not recommended for cutting steel wheels or pinions. The correct angle in which to sharpen fly cutters is simply to grind the stock away from the back of the cutter sufficiently so the cutting edge will cut and there will be no drag back of the cutting edge. Fly cutters must be run at a high speed, the highest speed possible that you can obtain with your equipment. If the cutting edges are well-polished and with high speed, the cutter will leave a polished surface. Fly cutters are ideal for cutting plastics or wooden wheels.

DRE: Technical information sent to the applicants of the H.I.A. examination cautions that a spreading punch must not be used on the Elgin or Hamilton grooved staffs when putting in a new grooved staff. Why are these precautions to be heeded?

Answer: The Elgin and Hamilton staffs are designed so that a broken staff can be removed by simply driving them out, breaking the riveting rim, thus saving a lathe operation of cutting the hub away. When driving them out of the wheel, the small riveting shoulder is broken off without damaging the balance wheel. It is important therefore not to spread the riveting shoulder, but to use a flat-faced punch, setting the riveting shoulder down tight on the balance wheel.

CTT: I have a few questions which have me confused. Your answers will be appreciated. 1. What is meant by a fast and slow pinning point? 2. Will a hairspring not perfectly true on the collet create a position error? 3. If a balance is in perfect poise will the slot in the hairspring collet create out-of-poise condition that will affect the position rate? 4. Will the use of olive hole jewels for balance pivots reduce the loss in rate between dial and pendant positions?

Answer: 1. When a watch is tested in pendant position, the watch will gain in that position in which the first half of the inner coil is upwards. 2. Any out-of-poise condition any place in the balance unit will cause a position error. 3. The rate of the watch will be faster in the low motion, in that in which the slot is upwards. 4. Close rates can be obtained by the use of olive hole jewels. In other words, olive hole jewels are essential for close timing.

AD: I recently took in a French clock for repair and cleaning. The suspension spring was broken, so I procured a new one. I now find the clock runs gradually slower as the mainspring runs down. Can anything be done to equalize the rates? This is an 8-day clock.

Answer: By slightly making a gradual reduction in the thickness of the suspension spring toward its lower end will improve the rate. This calls for great care so as not to make too much reduction the first time. Time the clock fully wound and partly run down, and then compare the rates. You can then tell if further reduction is necessary for the suspension spring.

JL: This may be a simple question. When using a jeweler's saw—I mean the real fine saw—which is the proper way to insert the saw blades into the frame so the saw will cut on the forward stroke like a carpenter's saw, or we might say, put the blade in backwards so the cutting is done on the return stroke?

Answer: You will find that by inserting the blade so as to cut on the return stroke or the pulling stroke, you will have better control and are much less liable to break the saw blade.

BMJ: Where I am working, a discussion came up as to the effect of replacing a

mainspring of different widths but of the same thickness as the original mainspring. For instance, if the original mainspring is 1.25 wide and .07 thick and a mainspring 1.00 wide and .07 thick is replaced, what effect will it have on timekeeping?

Answer: The pulling power of two mainsprings of the same thickness but of different widths would vary in pulling power in direct proportion to their width. A difference in the width of the two mainsprings is .25 or one-fifth of 1.25. Consequently, the narrower spring will pull one-fifth less, or decrease the arc of the balance by one-fifth of its original arc. If the original spring caused the balance to make an arc of 1¼ turns or 420 degrees, the substituted spring would cut this motion down one-fifth, or 336 degrees, which would be considerably less than a full turn.

RP: I have of my own a marine chronometer made by Henry Appleton, 30 Southampton Row, London, England, No. 607. It was given to me as a present by a friend in the U. S. A. I would be grateful if you could give me the age. I recently completely cleaned and re-polished it and it runs now with a daily rate of rather less than a second's gain. For instance, the normal weekly gain is between 2 and 2½ seconds. Do you think it is possible to get it closer than this? Literature on this type of clock seems scarce. Should the chain be oiled, and if so, with what? How should it be cleaned? I assume the teeth of the escapement should not be lubricated. Is this correct? In removing the balance, should the spring be disconnected from the bridge by unscrewing, or left attached and removed like a watch balance?

Answer: I am sorry to report that after a thorough search I cannot furnish any information pertaining to the Henry Appleton chronometer. Perhaps some of our readers may enlighten us and if so, I shall be happy to forward information I receive. It may be possible that Henry Appleton had this chronometer made to order by some outside manufacturer and had his name inscribed on the dial, as this was the custom during the early period. While your chronometer is showing a good rate for an old instrument, it may be possible that you can improve the rate by checking for temperature adjustment. It may have been in the hands of some inexperienced workman and the temperature adjustment

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disturbed by possibly moving the screws or bending the rims of the balances, or perhaps by separating the steel or brass rims.

In making the temperature test, I would suggest you test between 45 degrees F. and 95 degrees F. The chain may be cleaned and well-brushed in naphtha and thoroughly dried. Then immerse the chain in clock oil, flexing it so the oil will penetrate all the chain links. The surface oil may be wiped off with a linen cloth. The escape wheel teeth should not be lubricated, but left dry, as well as the locking jewel, impulse jewel and unlocking jewel. If the escapement is oiled, a change in rate will occur with the changing oil conditions.

It is a safe precaution to release the hairspring before moving the balance bridge; however, with care, the whole unit may be removed the same as you would remove a balance and balance bridge in the ordinary watch. I cannot warn all of our readers too strongly never to attempt to remove a chronometer balance before releasing all mainspring power, also the retaining power. If you don't let the power down, make certain to block the train, cutting off all power at the escapement before lifting the balance out.

JLD: Recently a customer brought in an old watch, a family heirloom. It had a peculiar balance staff—a straight rod with two small ears that the escape teeth would contact. It had a chain drive, key-winder, and double case made of silver and a very heavy crystal. As I have never had any experience with a watch of this kind, I had to refuse the job of putting it in order. I was interested, however, to note the name on the plates, "William Lucas of Liverpool." Can you furnish any information?

Answer: The watch you refer to has a verge escapement commonly employed during that period. The escapement was employed as late as 1840. Our records show that William Lucas carried on a watch-making establishment around 1825.

A jeweler who pays his help well always has help that pays him well.

* * *

A jeweler who watches his pennies usually winds up watching his dollars.

Watchmaker's Contest

A.H.&J. Reader Ideas on Practical Bench Methods, Experiences or Tools.

A. H. & J. is pleased to announce the following winners of its October Watchmakers' Contest:

First prize: One Arnold Universal case opening wrench and bench block goes to Mr. H. Riddington, High Street, Mildenhall, Bury St. Edmund's, Suffolk, England, for his "Softening Balance Staffs", Contest Entry #34.

Second prize: 12-piece lathe set consisting of grinders, buffs, brushes and end mills plus bench block goes to Mr. W. S. Henderson, Davidson, North Carolina, for his "Replacing Arbor in Pallets of Small Watches," Contest Enrty #35.

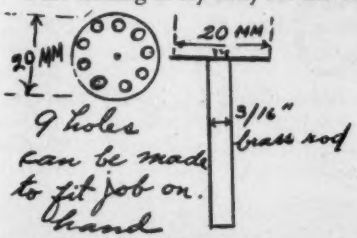
Third prize: Parts cleaning holder, cleaning brush and movement holder goes to Mr. V. M. Stark, The Time Clinic, Dayton, Iowa, for his "Tool to Straighten Pivots", Contest Entry #36.

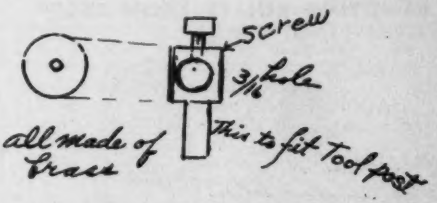
HOLDING CLOCK ARBORS TO POLISH PIVOTS

CONTEST ENTRY #37

I am sending in my entry for the Watchmakers' Contest. It is a device for holding clock arbors to polish the pivots.

I use this for long arbors—have the pivot come through one of the holes in the plate.



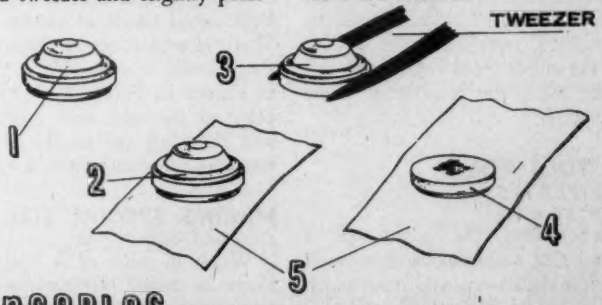


HOW TO REMOVE INCABLOC CAP JEWEL

CONTEST ENTRY #38

For the past eight years I have been removing Incabloc cap jewels from the cup-like retainer simply by holding the retainer with a tweezer and slightly pressing the cap jewel against (onto) a piece of scotch tape.

This method has never failed me as yet and I am proud to have thought of this idea while others are still shaking the assembly in benzine, naphthal, alcohol and other chemicals to remove the cap jewel from the retainer.



INCABLOC JEWEL ASSEMBLY

A. Remove Incabloc jewel assembly from balance bridge by releasing lyre-shape spring.

B. Place jewel assembly as shown in Figure 1, cap jewel down.

C. Gently place assembly onto the adhesive side of a piece of scotch tape as shown by Figures 2 and 5.

D. Then pick up assembly with tweezer (fragmentary) as shown in Figure 3. You will find the cap jewel stuck onto the scotch tape as shown by Figure 4.

GASKETS FOR WATERPROOF WATCHES

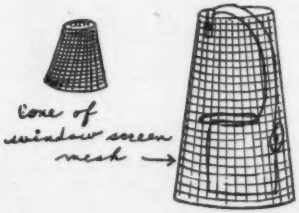
CONTEST ENTRY #39

There is no need to let any round waterproof watch go out without a new gasket in the back. Get a piece of plastic upholstery material of the proper thickness (about .50 to .60mm) and stick it to a 1½" cement brass with a heavy grease.

Turn the lathe at a high rate of speed and proceed to cut out several gaskets of different sizes at one time by a razor blade or a sharp pegwood knife. With a little practice you can cut them perfect, and a yard of material will cut hundreds of gaskets and cost very little.

REMOVING ROLLER FROM STAFF

CONTEST ENTRY #40



I've often found that when I wanted to remove a roller from the staff while the staff and the wheel were on the staking tool die, the roller flipped off into space and I've lost many of them.

I've corrected this however, by making a cone of ordinary window screening which when fitted over the entire staking tool, stops the roller from flying and you can also see what you are doing when tapping the staff.

THIMBLE TOOL FOR HOLDING PLATES

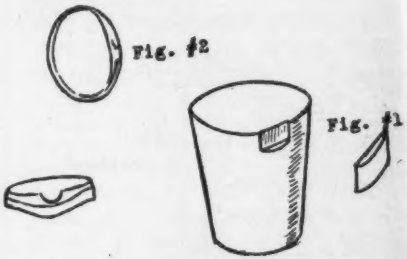
CONTEST ENTRY #41

When assembling the plates of a watch, I find that a thimble with a small hollow tube soldered onto it, into which a piece of pegwood is inserted, makes a very handy tool to hold the plates in place while working the wheel pivots into their holes and, also while running in the respective plate screws.

With this simple tool you do not mar up the plates nor is it necessary to place your finger on them and leave your prints. The pegwood should be fairly heavy and not too long.

DUST SEAL

CONTEST ENTRY #42



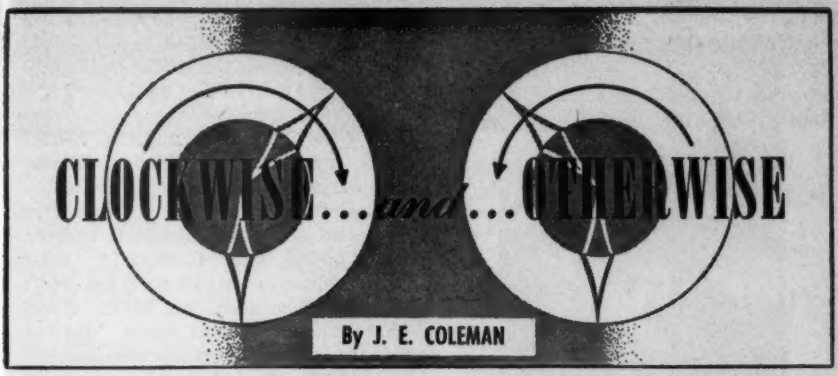
A lot of watches that come in for repairs have a much too large opening for the stem which, if not corrected, will allow dust to enter the watch and cause a comeback in a short time.

A very simple way to make a dust seal, which is also very effective, is to take a common cork such as is used for thermos bottles and cut it as shown in Figure 1. This piece of cork can then be cut with a sharp knife or razor blade to fit the case as shown in Figure 2. It can just set in place or be held with crystal cement. It will press up against the stem when the watch is cased and form a very good seal.

MAKING SPECIAL SIZE GRAVERS

CONTEST ENTRY #43

When in need of a particular size or shape of small turning graver, I take a worn burr and stone the end to the correct size and shape. I have used one for two years and find it gives very good service and compares favorably with my carboloy gravers.



OTHERWISE

The "When Zit?" illustrated in the September "Otherwise" was from an advertisement in one of the trade journals for August, 1910.

Photo bracelets and photos with wrist watches are currently being featured in ads and stores. How new is this style? Here is another "When Zit?" for this month.

Mr. Robert F. Schneider came through with about the closest full answer to the August "What's Zit?" and his letter follows:

Dear Mr. Coleman:

I like your "What's Zit?" and I'll try a guess at it. This is the way I made my guess:

1. The "thing" appears to be three large pocket watch movements—say 16-S or 18, probably R. R. grade, or better.

2. The mounting appears, through the screen dots of the reproduction, to be a flexible sewn leather affair.

3. The name on the dials looks as though it could be "Howard." (I like Howards.)

4. The fact that the movements are held in an apparently flexible mount seems to rule out any stationary usage or time lock set-up.

5. The loops at the ends of the leather mounting suggest that the affair was to be carried on the person by means of some kind of strap or belt.

6. The timing job must have been something like navigation or precise military operations of some kind to require three movements.

7. The use of watch movements suggests premium on space and weights.

8. Strapping the affair to a person, as the mounting seems to suggest, might be done to absorb severe shock or vibration.

9. From the style of the disks, I should think that the date would probably be not later than 1910 or so.

From these points, I guess that the "What's Zit?" is a chronometer assembly to be carried on the person and used in either early aerial navigation or aboard the early torpedo boats, or possibly sub chasers.

I'll be interested to see whether I score a near miss or am clear off the target.

Thanks again for the data you furnished me several years ago on the "grasshopper" escapement.

ROBERT F. SCHNEIDER
896 Sterling Place
Brooklyn 16, New York

Without question, about the biggest event in the "C & O" office this month was the secretary's "happy" birthday (we state it thus because she consistently does it that way—always puts that word "happy" in).

Those of us who have numbered a few more than her three often fail to stress the word "happy," and just merely have a birthday. One of the features that added

Mr. Coleman invites your questions. If your question requires a direct answer, please enclose a self-addressed, stamped envelope. It is impossible through correspondence to give valuations of antique timepieces; questions of this nature cannot be answered

C. & O. "Secretary"

greatly to her happiness on this occasion was the little dress all covered with "clocks" (I'm sure they can't be plain in the cut) because she discovered it.

It came about in this manner: Her dad, who is a sports car enthusiast, had a birthday a couple of months back and Jan was uptown on a shopping tour with her grandmother when they ran across a piece of print-goods covered with automobiles. It was decided to get a piece and make him a sport shirt for his birthday. Jan was in on the making as well as the purchase of the cloth, and was so enthused over the project she could not keep it a secret. Came the day: The shirt was presented and the incident was past history, at least for the grown-ups involved.

About a month later when Jan was again touring the piece goods department (and to a certain degree, upon her own, because grandmother's attention was concentrated upon the business at hand) she set up a howl of glee as only a three-year-old can, saying: "Here is my happy birthday sport shirt."

She had discovered a piece of print covered with clocks. Of course a garment of that particular type (sport shirt) just doesn't work for a tiny one, and the end result was the frock of the birthday picture.

We appreciate the cards and remembrances more than words can describe. Among them were the marine-type clock just above the old Underwood; an 18-S Waltham, key-wind watch in heavy silver hunting case, Movement No. 434,958 (about 1870) from Mr. George E. Martin of Kingsport, Tennessee; and a little clock book illustrating animated German clocks from Professor Frederic Whitsell of Sewanee, Tennessee.

Mayor James Norton of Winchester, Tennessee, sent down the clock, and with the aid of Mr. Walter E. Mutz (of Chelsea Clock Company) we just got it restored in time for the occasion. Mr. Mutz, in addition to sending material, wrote: "Our records show that Chelsea Marine Clock No. 83,822 was shipped on November 27, 1912, to T. S. & J. D. Negus, who are now located at 69 Pearl Street, New York City. This firm which was one of Chelsea's first dealers, was founded in 1848, located then at 100 Wall Street, moving later to 140 Water Street. The concern has been in the same family hands for a good many years. As a matter of fact, Mr. Negus III is now with the store."

A card from Mr. Hamilton Pease (51 Empire Street, Providence, Rhode Island) says that he is sending down a rare old 16-S movement. By the time her cake with four candles upon it gets here we hope to have all her timepieces catalogued, along with every bit of available history on each individual piece.

* * *

One of the big events at the Denver G.H.Q. this month, as seen from here, was the publication of a new book catalog. It is our thought that this is the largest horological publication catalog ever issued in the western hemisphere. There are 32 6-by-9-inch pages on high-gloss permanent stock paper, listing just about every available thing in horological publications. We hear that Captain Wayne Hulitzky (A. H. & J. Ad Manager) was the skipper on the bridge for this operation, and we have a strong suspicion that he probably had every able-bodied hand around the place in his crew before the cruise was over.

We've often lamented that possibly the horological profession was the most "under-read" of them all—a position we were forced into by contact with so many men

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who did not read—would not read. Some even boasted that they were not going to read.

The 1950s are different from the 1920s and 30s, and the 1960s will demand even more reading and preparation. Before the Levin's started *Horology* (Los Angeles, 1934) there was not a single all-horological publication in the U. S.

* * *

Here's a very fine letter from Mr. Robert Phillips of Toronto, Canada:

Dear Mr. Coleman:

By way of introduction, you may just remember speaking to me for five minutes at the U.H.A.A. convention at Charlotte, North Carolina.

I have for many years followed your C. & O. articles. I have long admired your technique. However, in your May, 1954, issue, your article on wooden movements was most excellent.

I am a watchmaker and seldom do a clock, but one cannot help but admire work done on restoring by clockmakers. In the Toronto area we have several outstanding repair men who are members of our organization, and I have had the opportunity of seeing their work.

This letter is to congratulate you on the fine articles on questions asked, and to thank you for the good will and fellowship that has been developed by you. I might add—international good will—for people from all over the world feel free to write to you.

Thank you for many years of enjoyment and knowledge.

ROBERT PHILLIPS,
Secretary Ontario Watchmakers Assn.
8 Ridge Park Drive
Toronto 5, Ontario, Canada

Yes, I do remember you at Charlotte (1947). One of our chief speakers was Mr. Frank Mercer of London, and your registration from Canada added to the international atmosphere of that meeting. Like so many convention contacts, ours was all too short. As I recall, I made over 75 photos of that convention—which left almost no time for contacts.

* * *

Mr. Ole P. Olson, Kalispell, Montana, writes:

Dear Mr. Coleman:

Your mention in last month's A. H. & J. about Charles DeLong was most interesting. I have read about him in Major Chamberlain's writings, and also in some of the articles Mr. DeLong wrote for Horology magazine. From these articles I have received much inspiration and admiration for the ability Mr. DeLong had.

It would be a great pleasure to know more about Mr. DeLong, so I hope you can dig up some more on him before the people who knew him pass away.

Your "Clockwise and Otherwise" continues to be most interesting and informative.

OLE P. OLSON
Route 1
Kalispell, Montana

We've been thinking along the lines Mr. Olson suggests and hope that we may present something in 1956.

* * *

Good cooperation was shown by Friend Theron Sowers, San Jose, California, on Mr. Bennett's and Mr. Gosnell's questions in the September column.

Dear Mr. Coleman:

I have read the letters of Mr. Bennett and Mr. Gosnell as well as your comments. These letters interest me very much for I have had the pleasure of visiting the Seth Thomas factory in 1925. At this time I was their assistant service manager working out of their New York sales office.

While I was at the factory their special order department was constructing a movement on special order of the type you mentioned in both of these letters. You may also wish to know that at that date the Seth Thomas sales office in New York had on display an especially made sidereal clock which has a seconds-beat pendulum, jewelled pallets, and all pivots had jewelled bearings. Two weights were used. The pivots on the weight pulleys were also jewelled. The movement rested on a large cast iron base which was designed so that air pressure could be used to control regulation. This also had a sweep-second center.

I repaired a clock for a local jeweler within the last few months that is a Seth Thomas weight regulator, seconds-beat pendulum, mercury bob with shot cup, having a center sweep-hand, jewelled pallets, large keystone brass (nickel plated) plates, mainaining power main wheel, and thumb screw adjustment of beat.

Mr. Bennett's description of the case is perfect. I also believe that Mr. Gosnell is writing about the same type of movement.

Am sure that pictures could be obtained if cost to photographer were guaranteed. Present owner states that he has seen the original invoice of the clock, which he claims to be 80 years old.

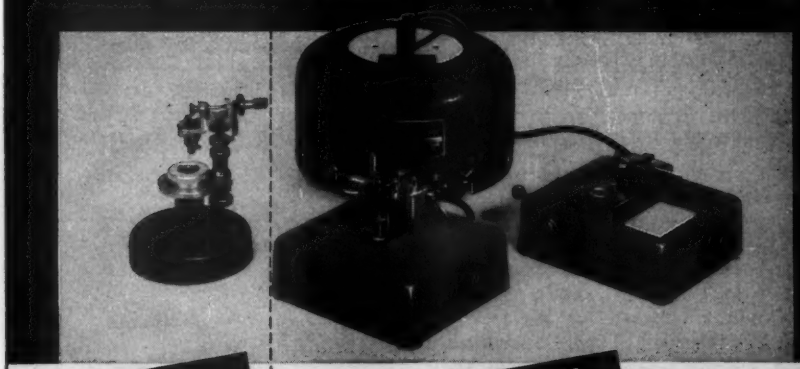
With best personal regards.

THERON O. SOWERS
210 South First street
San Jose 13, California

* * *

Your column is really crying for help.

Amazing development in hairspring vibrating!



OLD

NEW!

New Electronic Instruments used exclusively by Hairspring Vibrating Co. . . . developed after many years of research . . . introduce a new standard of achievement in hairspring vibrating . . . unmatched by any other supplier.

Frequencies range from 4 per second for **WATCHMAKERS** to 100 per second for: Research Laboratories • Jet Aircraft • Bureau of Standards • Guided Missiles • Atomic Energy Commission

New! An **ELECTRONIC EAR** picks up the frequency of the balance in exactly the same manner that it functions in the watch or instrument. Does not inject errors such as bouncing the wheel or interfering with hairspring movement.

A **CONSTANT MOTION,** equal to that which is a pre-requisite for perfect time keeping, is maintained by a reciprocal air jet.

UNINTERRUPTED OSCILLATIONS are measured against an Electronic frequency standard.

HAIRSPRING VIBRATING: Flat — $1.75, Breguet — $2.50. STAFF SERVICE: Staff fitted—balance trued and poised—hairspring adjusted $1.75
Staff (if ordered with new hairspring) returned in VIBRA PAC ... $1.25

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One of the most evasive things we've run into is a timepiece called "Pigeon Timer" and data and information upon the same seems to be nonexistent. Honestly, I've never seen or had my hands upon one—they just don't seem to exist in this part of the country. If there are any pigeon-racing clubs hereabouts I can't locate them.

Here are two inquiries, one from Mr. Billie Williamson and one from Mr. L. A. Hemmer.

Dear Mr. Coleman:

I am writing you for some information on pigeon racing timer clocks. I have overhauled several German makes, but luckily no parts were needed. I have been approached by the local racing club to repair their clocks, as they have to send theirs down to Indiana. This local club uses Belgium made clocks for their races, and also a few American made clocks—I believe Elgin.

Could you possibly tell me where I could obtain information and parts for these different make clocks.

I have been an avid fan of "Clockwise and Otherwise" for several years. Checking back through my old issues, I find nothing about these pigeon racing clock timers. So if you could give me any information at all it would be deeply appreciated.

Keep up the good work you are doing for the clock repair field.

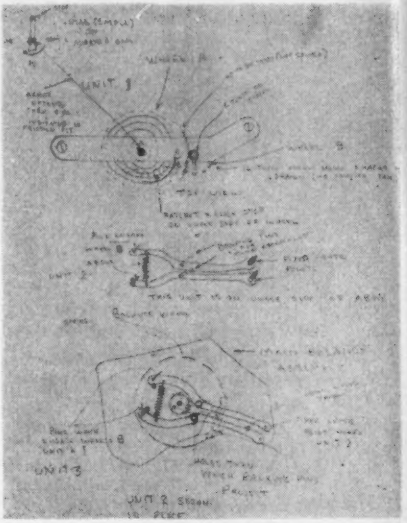
BILLIE E. WILLIAMSON
9 North Eighth Street
Manitowoc, Wisconsin

Dear Mr. Coleman:

As is true of so many of us who read your column with interest, I have at this time a question that I would like to have answered.

I am sending a sketch of a portion of the escapement of a Benzing pigeon timer. Turning the arbor, which is attached to a spring pinned like a hairspring, causes a Roskopf-type escape action on the two levers which in turn adjust the banking pins of the escapement proper of the time train. On the dial is a red dial (small) graduated from 0 by intervals of 15 through 45. At the 0-point and slightly to the right, is an index stop pin.

I am curious as to why this banking pin arrangement is used instead of one which could not be altered except by a watchmaker, and if so, why is it graduated as it is.



Mr. Hemmer's Sketch

L. A. HEMMER
4943 North River Road
Salem, Oregon

If any of our readers are familiar with these pieces, won't you please communicate with us. We'll see that these gentlemen get the data promptly, and will also keep a copy for the file and future reference. Also, addresses of importers, makers, etc., would be appreciated, as we would like to get catalogs for the files.

Thanks for the cooperation.

J. & J.

CLOCKWISE

Dear Mr. Coleman:

I have a ship's clock which was brought to my store for repair. I have completed the repairs and have become curious as to the age of the clock. I would like to know

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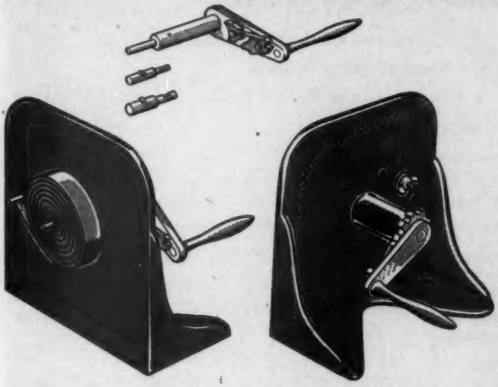

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any history that might be available on the manufacturers. On the dial of the clock is the following identification, "Imray & Son, 102 Minories, London, No. 2637." I wrote a letter to Imray & Sons, but it came back unopened and stamped, "Gone Away."

HUGH IRVIN

753 Newmark
Empire, Oregon

Dear Mr. Irvin:

We are unable to locate this firm in any of the listings, and will have to rely upon our readers. Perhaps someone is familiar with these clocks, so marked, and will drop us a card.

As they are not listed, and your letter was returned, marked "Gone Away," I suspect this firm was a store or merchant, rather than an actual maker.

J. E. C.

Dear Mr. Coleman:

Can you advise me if there is any company from which I can get parts for the Boots Boy electric clock, other than Technical Aids, Inc., Radio City Station, New York 19, New York?

I mailed this company the train of wheels, with the rotor in, for a sample and asked for a new train. They put a bushing in the main pinion, and the clock runs so noisily that I would not think of turning a job of this sort over to a customer.

ERWIN ZUEBLSKE

958 Crescent
Port Huron, Michigan

Dear Mr. Zueblske:

We have no other address for service or parts on the Boots Boy electric clock. The clock in question, I believe, is one of those little mystery clocks whose hands are rotating glass discs. Naturally there is a risk when shipping it. The motor portion should be easily detachable—in fact, I think the whole base comes off. Thus you might retain the glass for safety and ship the motor to Mr. William A. Phelps, 4106½ Glenway Avenue, Cincinnati 5, Ohio. He can restore it to its original quiet running condition.

J. E. C.

Dear Mr. Coleman:

I have an old marine 8-day clock that was built by the Seth Thomas Clock Com-

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Trois Roses #111

pany, but I don't know the exact date of it, so I can't know if it is being made today. It is an 8-day lever type with two mainsprings cased like the mainspring in a watch.

I need an escape wheel for the clock and am wondering if you can tell me where I might get a new wheel. The address on the wooden back reads: "Eight-day Lever, Seth Thomas, Thomaston, Connecticut." Perhaps you can tell me if I can buy a new wheel or where I could get one repaired or made. Do you think I should send you the wheel for inspection or identification?

EARL C. WALKER

Box 514
Calimesa, California

Dear Mr. Walker:

Material for these old clocks has long been obsolete, so you will have to have a wheel cut to match the old one. The Hjalmar J. Olsen Company (Mr. George Olsen) 26 Templeton Parkway, Watertown, Massachusetts, makes a specialty of these fine wheels, and can cut a duplicate of the old wheel.

J. E. C.

Dear Mr. Coleman:

Would you be so kind as to tell me if parts are available for a Sangamo electric clock. The clock is No. 9361, Type B-7, Style 5720.

Also, is there anyone on this coast that I could send an hour and half-hour strike to have a verge made? I do a lot of clock work, but am not a clock repairman at heart. I have an overload of watch work all the time—I like that—besides doing my own diamond setting and running a live retail business.

For a point of information, is there a set rule for making a verge? Are they figured according to the amount of teeth in the escape wheel?

WILL F. POOLE

650 Plumas Street
Yuba City, California

Dear Mr. Poole:

Sangamo made electric clocks between 1926 and 1928, and was sold to General Time Instrument Corporation around 1930. We know of no source of parts. Possibly a small advertisement in the classified section of A. H. & J. might strike some shop with two or three of these old clocks on hand. Be sure to state what part or parts are needed—your letter does not designate them.

Yes, there are very "set" rules for making a verge. The number of the teeth plays only a minor part. The type of escapement, the diameter of the escape wheel, etc., are all governing factors. Goodrich, in "The Modern Clock," devotes about 60 pages to this.

We believe you are located closer to San Francisco than any other address we have for trade shops. Write Mr. Hans Has, proprietor of the Washington Clock Company, 2998 Washington Street, San Francisco 15, California.

J. E. C.

Dear Mr. Coleman:

On a recent trip through Arkansas, I found an unusual clock in an old junk shop, with this legend on the dial and on the back of the case: "Chas. Kirk, Patent,

1847."

What do we know of this Charles Kirk? He is scarcely mentioned in the clock books I have. The clock is round, about 12 inches in diameter, and the case is covered with a plaster of Paris-like substance which has been gold-leafed in places. The movement is heavily built and has a double escape wheel. The balance wheel is very large, about 1½ inches in diameter, brass with steel spokes.

On this same trip, I acquired an E. Howard banjo clock. It has turned out to be the most excellent timekeeper in my collection. How about a write-up on this boy Howard? I understand he was a stickler for detail and good workmanship.

DURWARD G. SIEGRIST

5944 Brooklyn
Kansas City 30, Missouri

Dear Mr. Siegrist:

At the moment, very little is available on Charles Kirk. He must have been quite a mechanic, for he was experimenting with escapements when other makers were content to make money by producing conventional clocks. Honestly, you will have to allow us a "rain check" on him.

The patent you mentioned was granted Mr. Kirk (or Kirke) April 3, 1847. It was No. 5,045. He was active in the clock business around Bristol and Walcott from about 1828 to around the middle 1840s. In addition to the 1847 patent, he was granted patent No. 3,233 on August 26, 1843.

About 1833 he sold his business to E. C. Brewester, but continued to run it for the next four years, and then he was with his sons at Walcott, Connecticut. In the early 1840s it was "Kirke & Todd" at Walcott. You were very lucky to run upon this fine example of Early American clockmaking, and were even luckier to find the Howard banjo.

There has been a great deal written about Mr. Edward Howard. You have right near you Mr. Paul Blanchat, 316 All Hallows Road, Wichita, Kansas, an ardent Howard collector and a student of Howard history. It was our privilege to send him not long ago a photostat copy of Mr. Howard's obituary as it appeared at the time of his death in 1904.

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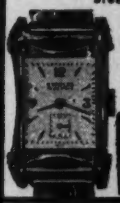

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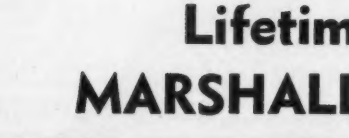

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If you can secure from your local library a copy of Major Chamberlain's "It's About Time," there is an excellent photo and biography of Mr. Howard, beginning on page 419. We hope to be able to forward more on Charles Kirk in the near future.

J. E. C.

Dear Mr. Coleman:

Several years ago we wrote to you, asking where to send a large music box mainspring barrel for replacing the mainspring. You gave us an address in the East. Could you supply us again with an address? The music box is the large type that plays large perforated metal discs.

CHARLES SCHAEFFER
1405 Commercial Street
Bellingham, Washington

Dear Mr. Schaeffer:

Write Mr. Glenn P. Heckert, 850 Phillips Road N. E., Massillon, Ohio, for instructions as to shipping the music box mainspring barrel to him.

J. E. C.

Dear Mr. Coleman:

I have a new German 400-day anniversary clock which fails to run. I have checked the beat, wheel train, and changed the pendulum springs to both weak and strong. The clock still refuses to go. The bottom of the pendulum is aligned perfectly with the cup in the base when the base is level. The train has end-play on all wheels, with no bind between the plates. Can you suggest anything I might have overlooked?

D. W. CRISSMAN
16 Heilman Street
Montgomery, Pennsylvania

Dear Mr. Crissman:

Spotting the trouble in one of these 400-day clocks that is "acting up" is generally difficult, even with the clock in hand. By mail—well, it is almost impossible.

First, let me say there is but one, and only one, suspension spring strength for that particular clock, i. e., the one that naturally makes the pendulum beat the proper number of beats per minute it requires. Regular sizes are all 8 beats-per-minute, and some of the miniatures beat 10. Thus if you have the proper strength spring on it, that can't be the cause of stoppage.

You say you checked the train for complete freedom and know that the clock sits level. We presume that the escapement has not been tampered with—that is, the pallets moved or the center distance between verge and escape wheel changed. With all these points in order, the clock is either out of beat, the fork pinches the pallet tail-pin, or the fork is set too high up on the suspension spring.

The pallet tail-pin must work freely in the fork. The least friction or pinching here robs the clock of all its driving power.

You can readily see that if the fork is mounted too near the top of the suspension spring, the pendulum will not turn far enough around to permit unlocking. Many workmen not familiar with the 400-day clock do not know how to put them in beat.

Set the pendulum rotating—about one turn—and observe closely the escapement. Watch to see how far the balls continue to rotate after the escape wheel tooth drops onto the pallet. This rotation after and beyond the drop should be equal upon both pallets, generally about one-quarter turn, very easily observed on the four-ball pendulum.

Now if you detect more movement after the tooth drops to the pallet on one side than on the other, turn the suspension saddle at the top slightly in the direction of the shortest outside motion. Do this until the outside turn or motion—that is, the turn beyond the point at which the escape wheel tooth drops to the pallet—is equal on both sides. Then the clock is in beat.

The book department of A. H. & J. can supply a copy of the new Horolovar 400-Day Clock Repair Guide for $3.00, plus ten cents postage. It covers all this and other details, and shows exactly where the fork should be clamped to the suspension spring. It also shows the correct spring and completely covers the repair and adjustment of these clocks.

J. E. C.

Dear Mr. Coleman:

We are sending you a photograph of a clock brought in to us for appraisal. Can you tell us if it is one of many alike, or if there were just a few made? If it is valu-

able, can you give us the address of anyone who does appraisals by mail?

The clock measurements are 23½ inches long by 18 inches high. It is of cast iron, with the figures and decorations bronzed at one time, but this has worn off. The inscriptions are: "Ansonia Clock Co., Patented A, June 14, 81, New York, U.S.A." and "Patented June 18, 1882."

There is a piece missing from the top of the clock mounting. Could you say what it was? Any information that you can give us will be appreciated.

JACK D. GORTHY

1280 Umpqua Avenue
Roseburg, Oregon

Dear Mr. Gorthy:

From about 1890 to 1910, Ansonia produced this type of clock by the tens of thousands, and there are literally hundreds of them in ciculation today. This identical number is illustrated on page 132 of Ansonia's catalogue for 1907. It was called "Music and Poetry," came finished in gilt or Japanese bronze, list each, $42.50.

It gets its name because the two statuettes on either side represent music and poetry. The missing part atop your case was a small urn that extended slightly above the heads of the statuettes.

For mail appraisal write Mr. James Hamilton, Clock Manor, 1901 East Colfax Avenue, Denver 6, Colorado.

J. E. C.

Dear Mr. Coleman:

I'm just an amateur in the clock field and have a sort of puzzler at the moment. I would appreciate any assistance you may lend.

The clock in question is a French clock, round movement, about 4 inches in diameter, 8-day strike. Name on the back plate is, "Guyenot A Paris, No. 740. This clock has no pendulum bob and no suspension spring (if that is what it takes). However, regarding the latter, I see no place to attach same, as on the very top there is a regulating rod coming through, with a hole on the rear end. This is about one-half inch higher than another rod riveted onto the rear plate. This has two small holes, henceforth I cannot understand where the suspension spring is to be hung, if that is what is needed in this instance.

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Attached to the verge is a wire which extends out and down for about three inches. This is at the end, bent away from the movement. At right angles to the wire is a flat segment of brass with a long, recetangular slit cut in it. It is open at the end, no doubt to allow for entry of the suspension spring, or whatever it may be that should go through.

If the above is anywhere near clear, I would appreciate your informing me as to what is needed to replace this in A-1 condition, and if material is available or must be made up.

F. MICHAEL
323-D West Ninth Avenue
Amarillo, Texas

Dear Mr. Michael:

You have a "French Silk Suspension." These clocks never had the conventional suspension spring. This was a popular method of manufacture with the French up until Achille Brocot, around 1833, invented his now very famous suspension spring with means for adjusting (regulating) from the front of the dial.

Take a small silk thread; pass it through the hole in the regulating staff, down through the hole in the post riveted to the plate. Form a loop approximately one inch long; bring the thread up and tie in the hole in the riveted staff back next to the back plate. Now turn the regulating staff and it will reel up the loop until it is only about a half-inch below the staff riveted to the back plate. Your pendulum merely hooks into this loop. Thus to regulate the piece, you take up the loop to shorten (fast) the pendulum, or let out on it to lengthen (slow) the pendulum.

Quite naturally these pendulums show a wide difference in both length and weight. Anything I might say is just a "fair guess." The length you can (and will) determine by timing the clock. In the weight, you have a wide latitude, i. e., it is not critical. To one accustomed to handling American clocks, and even French clocks of later construction, all these silk suspended pendulums seem to be on the very light side. Generally the pendulum ball was a little larger than a quarter and a little less than the fifty-cent piece—the same goes for thickness. Turn up a piece of brass about that size, drill it from the edge to take a small wire, 20 or 22-gauge.

Take a small rectangular piece of brass about three-quarters of an inch long and file it to fit the crutch segment of your verge (a loose fit). Then polish it and drill from the end and slip it over the pendulum wire. Both this piece and the pendulum ball should fit friction-tight—tight enough to stay in place on the wire while you are timing the clock. Bend a little hook in the top end of the wire and hang the completed pendulum on the clock.

Position the rectangular piece on the pendulum wire so that the crutch segment of the verge will work about the midway point, and start the clock running. Bring it to time by raising or lowering the ball by sliding it on its wire. Now with the piece approximately "on time," take your pendulum off and lay the ball on an anvil. Take a pointed punch and strike one sharp blow right over the wire, to make the ball fast to the wire. Do the same (either extreme top or extreme bottom) to the little rectangle of brass. We now have the clock practically "on time" and there is no occasion for further moving of the ball.

The final (fine) regulation is had by taking up or letting out the silk loop. With the little brass square centered in the crutch-piece, a slight raising or lowering still keeps the crutch-piece upon it.

We do not locate this name in any of the maker lists and therefore conclude that Guyenot of Paris must have been a jeweler (dealer) who got his name stamped on clocks he was marketing. It isn't necessary to add that material of this type for hundred-year-old clocks is not available.

Crude as these instructions may sound, I'm sure that you can make a satisfactory pendulum from them. If we can be of further help, just drop us a line.

J. E. C.

Dear Mr. Coleman:

I need a mainspring wheel for an old Waterbury clock. How do I go about finding it?

RALPH J. AIKEN
6216 South Vermont Avenue
Los Angeles 44, California

Dear Mr. Aiken:

You won't find it. All of this old material has long since passed off the scene, and the only chance for a replacement is to have one "hand-tailored" to fit. If you have the old wheel, it will be fairly easy to duplicate. If it is entirely missing, a competent mechanic can determine correct measurements from the movement and make a new wheel.

Write to Mr. Joseph R. Smith, 1755 Hillhurst Avenue, Hollywood 27, California, or to Mr. Theron O. Sowers, 210 South First Street, San Jose 13, California.

J. E. C.

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WATCHMAKERS OF SWITZERLAND SCHOOL PROGRAM KIT

Shown above are some of the attractive pieces of literature included in the kit being furnished to U. S. schools for a study in time and precision. The units are applicable for study by students in the primary grades and up to college level.

A Watch-Conscious New Generation Coming Up . . . .

U.S. Retail Jewelers and Watchmakers Will Have To Be On Their Toes To Meet New Time Knowledge Being Instilled In School Kids By Latest Swiss Project.

CAVEAT EMPTOR, meaning "let the buyer beware," expresses a general legal rule that the buyer purchases at his peril. Despite the fact the average American consumer, literally plastered with the most powerful advertising anywhere in the world, has become rather well informed concerning the merchandise he buys—a so-called bargain misrepresenting low price over quality will make a sucker out of him every time, especially when he is shopping for merchandise with which he is unacquainted.

The consumer buying a watch, or having a watch serviced, with few exceptions understands only a fraction of what he should about his purchase. He utterly depends on the retailer or watchmaker for a fair deal. A proud tradition of heritage is responsible for the high degree of honesty and integrity in the jewelry profession —but, as in any other field, there are exceptions.

The unscrupulous jeweler and unprincipled watchmaker are on their way out of the picture eventually, if a campaign currently in operation succeeds—as it has every appearance of doing.

School Children Learn About Watches

Recently the Watchmakers of Switzerland Information Center, directed by Paul A. Tschudin, through its Educational Service Department began issuing kits for the study of time in classrooms, from primary grades to college level. The material in each kit includes a message to parents (to acquaint them with the students' new subject), lavishly illustrated-in-color study units, and complete teacher worksheets to guide the course of the lessons. The literature carries no advertising and is simply identified as a service of the Watchmakers of Switzerland, without charge.

In the primary grades, where the students are just learning to tell time, the kits provide printed clock dials with removable hands. The teacher uses two 10-inch dial Demonstrator Clocks—one for hour hand and the other for minute hand and combination of hour-and-minute hands. Each student receives two three-inch Desk Clocks (one for classroom use and the other for home study), and learns to tell time first by reading the hours, and then the quarters and minutes. Besides telling

The Study of Time kits being furnished to schools by Watchmakers of Switzerland will have a profound effect in the future on Mr. Retail Jeweler and Mr. Watchmaker.

time by the dummy clocks, the students learn to read Roman numerals. In addition to being impressed by the *importance* of time in daily living, the children learn facts about fine watches.

The elementary grades are acquainted with time-telling devices from earliest shadow-reading to modern quality watches with their advantage of interchangeable parts and superiority of jeweled-motion. They master time zones and the use of the watch as a compass. Their practical work includes construction of sun dials and pendulums, and they are urged to visit their local jeweler or watchmaker to learn about special-purpose watches, such as waterproof, self-winding, calendar, stop-watch, etc. They learn the *necessity* of the application of time.

The lesson units in general science for high school grades and up teach accuracy and precision in measurements. The development of the modern watch is traced, and the students become familiar with the jeweled-lever escapement. They learn the value of reliable *precision* in timekeeping.

Success of the School Program

Testifying to the popularity of the Swiss school program in the U. S. is the fact that 650,000 units were snapped up by schools in four months. Thousands more are clamoring for the course, and the Watchmakers of Switzerland Information Center is hurrying plans for 200,000 additional reprints. Even this reprint total is judged to be far from sufficient to satisfy the demand. The program is a costly one, but the long-range benefits to jewelers and watchmakers are incalculable.

The originators of the project set out to fascinate students with a new school course in the practicability of time—to learn the value of a good watch—and certainly succeeded in their efforts.

Purpose of the Project

Eventually, and perhaps sooner than we realize, a new consumer class will appear in the merchandising and servicing of watches in the U. S. The first evidence will be increased knowledge by the consumer in the functions and purposes of watches. The superiority of the jeweled-motion timepiece will be recognized, as will the necessity for proper maintenance.

Naturally, this will be a boon to both the retail jeweler and the watch repairman. More fine watches will be sold, and servicing will be more frequent. By the same token, the day will be gone when the jeweler and the man at the bench talk airily to the customer concerning the mechanics of a watch. The customer will ask intelligent questions, and expect intelligent answers. The sellers and servicers of watches will find it necessary—if they expect to stay ahead of their customers—to study their products, and study hard. They will bless the manufacturers and distributors for making available a vast amount of explanatory and selling literature.

The United Horological Association of America was probably the first trade organization to realize the value of the Swiss school program. From its headquarters in Denver, under the direction of Executive Secretary Orville R. Hagans, U.H.A.A. began sending the units to guilds for careful study by its members. The bibliographical references of the courses have been supplemented by the most complete list of horological study material in the U. S.

Currently, the units are in very short supply, and the guilds are being accommodated on a first-asked-for, first-serviced basis. After that, even the most isolated member-at-large will have an opportunity to study the program.

It will be a credit to the entire industry if not one retail jeweler or watchmaker will pass up the chance to study the Swiss school program—and be ready to meet the new crop of well-informed customers.

It's time to go back to school!

THE WATCH REPAIRMAN AND THE OSCILLOSCOPE

By Carl H. Anderson

DURING September and October we gave several talks and demonstrations of the use of the Oscilloscope in watch repairing and selling to local and state Guilds. We believe these were all very well received because we were invited to come back and talk again.

The first of these talks was given to the Lexington Guild of the Kentucky Watchmakers Association, Incorporated. A good crowd was in attendance and the meeting did not break up until a late hour, well beyond their usual adjournment time. The interest ran very high. Many valuable and interesting questions were asked and answered. This was followed by a talk to the Louisville Guild, where the attendance was the largest they have ever had. A great deal of interest was shown in the oscilloscope at both of these meetings. Questions were so numerous at the Louisville meeting that it did not break up until almost midnight. We have joined the Kentucky Watchmakers Association ourselves and are proud to be associated with such a swell bunch of fellows. The Association is undertaking a rather comprehensive advertising campaign to the public in one of the Louisville newspapers which has a state-wide circulation. Attention will be centered on directing the public's attention to having their watch repaired by one of the State's Registered Watchmakers.

We are now arranging similar talks to be given the other Guilds in Kentucky. Notice of these meetings will be mailed to all Watchmakers and Jewelers giving the place, date and time of meeting.

If any of our readers are interested in becoming a member of the Kentucky Watchmakers Association, full particulars may be had from Mr. George K. Kotheimer, Secretary, 607 South Fourth St., Louisville 2, Kentucky.

The Horological Association of Iowa, Inc., held one of their most successful annual conventions at Hotel Fort Des Moines in Des Moines on September 19. We were the principal speaker at the afternoon session. We do not remember the exact figure on the registration at the meeting, but we do remember it was in excess of 525. There are about 1,100 jewelers in Iowa, more than half of whom are also watchmakers. It must be considered as an extremely worthwhile accomplishment to have approximately one-half of the watchmakers and jewelers of the state in attendance at a convention. The entire floor of the hotel as well as several rooms on other floors was taken over by displays of manufacturers and wholesalers. All to whom we talked said buying was good, more than satisfactory. The officers of the Association are to be congratulated on holding one of the most successful conventions of their 45-year history.

Our talk and demonstration of the oscilloscope was so well received, we were invited to return in the spring of 1955 and give a similar talk to each of the Guilds in the state. Arrangements for these talks are now being made. Complete information, dates and places may be obtained by writing Mr. Hoyt D. Snyder, Secretary, Horological Association of Iowa, Inc., Humeston, Iowa. The cities in which these talks will probably be given include: Burlington, Davenport, Ottumwa, Des Moines, Waterloo, Cedar Rapids, Mason City, Fort Dodge, Sioux City,

Mr. Anderson will be glad to answer any question pertaining to the Oscilloscope. Queries should be sent to him in care of the American Horologist & Jeweler, with a stamped return envelope enclosed.

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Council Bluffs and Humeston. These meetings will probably not be held until the snow is off the roads in the Spring. We will spend about ten days to two weeks in Iowa holding these meetings. As soon as all arrangements are completed the list of cities and dates will be published in A. H. & J. It might be added that the Watchmakers of Iowa have one of the best organized and most active State Horological Associations anywhere in the U. S. The same can be said for several of the local Guilds in Iowa. The watchmakers of other states would do well to pattern after the boys in Iowa. The boys in Kentucky are likewise doing a mighty fine job of organizing their state.

The Waterloo, Iowa, Guild has taken on the study of the use of the oscilloscope as their major Guild project for the coming year. Each of the Guilds in Iowa adopts a program for the year in which some one topic is undertaken as the Guild's major activity. The Waterloo boys bought a scope and brought it down to the Des Moines convention so members of the other Iowa Guilds could see and examine it. They have already accumulated a very useful store of information and data of the use of the oscilloscope. They have also been quite successful in photographing their traces, and had several nice oscillograms on display at the meeting. The Waterloo Guild is to be congratulated on the fine work they have done. Other Guilds throughout the country would do well to adopt a similar program.

We are arranging a series of meetings of our own in Kentucky where we will give talks and actual demonstrations of the oscilloscope. The first of these meetings will probably be held in Lexington, Sunday afternoon, October 31, to be followed by similar Sunday afternoon meetings in Ashland, Louisville, Owensboro and Paducah during the month of November. Mimeographed announcements of these meetings will have been sent out first class mail to every Jeweler and Watchmaker (of whom we have any knowledge) prior to the publication of this issue of A. H. & J. If you did not receive an announcement of these meetings, full information may be had by writing The Institute of Horological Oscillography, P. O. Box 578, Lexington, Kentucky.

A similar series of meetings are at present under consideration for the state of West Virginia to follow the Kentucky meetings. The probable cities where these meetings will be held are Wheeling, Clarksburg, Charleston and Beckley. The exact dates and places will be announced in A. H. & J., at a later date.

All of the watchmakers and jewelers within a 100- to 150-mile radius of each city where a meeting is being held will be invited at attend these meetings. Since several of the meetings will be held in cities near state boundary lines, the watchmakers and jewelers in surrounding states will be invited to attend. For example, at the Ashland, Kentucky meeting, all watchmakers and jewelers in West Virginia and Ohio within a 100- to 150-mile radius will receive an invitation to the Ashland meeting.

Due to the exceptionally large attendance at similar previous meetings, all seats will be reserved. A reservation card will be enclosed with each invitation. Chairs

will only be provided for those who return their reservation card, as it is absolutely necessary to know how many chairs to provide and what size meeting room to reserve.

Since all meetings will be held at 2 o'clock on Sunday afternoons, this makes it possible for all who wish to attend to do so, since it will not be interfering with a regular business day. All meetings will start at 2 P.M. *sharp* and will probably be over by 5 P.M., thus allowing those in attendance who are from some distance away to return home that evening. For those who wish to have a personal conference with Mr. Anderson, he will be available at the hotel where each meeting is being held, from 9 A.M. until 12 noon of the morning of each meeting.

May we say these meetings will be well worth your attending as you will see an oscilloscope in actual use. You may bring your own watches for diagnosis, if you wish. The ladies will be welcome. Also many points on watch repairing will be discussed and thoroughly explained which have never appeared in print. At each meeting about one hour will be devoted to a question-and-answer period when those present may ask any question they wish and Mr. Anderson will answer it. Such question-and-answer periods have proven highly informative and beneficial at previous meetings.

Following the meetings in Kentucky and West Virginia, a similar series of meetings will probably be held in Ohio and then in Illinois. Readers in any state who are interested in having one of these meetings in their own city or at some nearby point are invited to write us and if sufficient interest is shown, the probabilities are that such a meeting can be arranged.

Oh yes, before we forget it. Admission at all meetings is *free,* the only cost to you is the 2c stamp you will have to put on your registration card when you return it. No collections will be taken up. All that is asked of you is that you return your registration card so you will be sure of a seat.

It is our sincere desire to hold as many as possible of these meetings during 1955. All we wish to do is to arrange our trip

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in a logical sequence of cities so we will not be driving backward and forward, retracing our steps, all over the state. In states which are at some distance from our home in Lexington, Kentucky, we will spend a week in such a state, moving from city to city each day. This will necessitate that a meeting be held each week day evening and on Sunday afternoons.

If you have a Guild in your town or a State Association that would be interested in these meetings, please write us and if at all possible arrangements will be made.

* * *

At the Iowa Convention, we had a most welcome constructive criticism of our articles in A. H. & J. A few of the boys said our articles were too far over their head. This we regret very much. It must be borne in mind at all times both by you and ourselves that A. H. & J. has all types of readers. Some are the most noted Horologists in the world, while others are beginners having only been in watchmaking school for a month or so. We have always tried to write these articles in what we believed to be simple enough phraseology to be understood by all. It seems we have failed in some instances. Others have criticized us for what they called the "childish way" in which we have explained some things. If you are confused at any time or do not thoroughly understand something we have written, please write us and we will try to clear it up for you. But—please enclose a stamp for your reply, 3c for regular mail and 6c for air mail. We are always pleased to hear from our readers.

Are you a regulator "pusher overer?" Just why do you move the regulator in the first place? We have had watches come to us for repair where the regulator had been pushed over until the tail was completely off of the cock-plate. Why shouldn't the watch be so repaired and adjusted that it would not be necessary to move the regulator from the center to keep it on correct time? Do you know that the world's best watches are made without a regulator? What would you do then? How much time do you waste every day in "regulator pushing?"

Are you a balance staff "knocker outer?" How many times have you knocked a balance staff out of a wheel and at the same time knocked the balance wheel out of true and poise by using a balance staff knock-out tool? How many hours have you spent in needlessly truing and poising such a balance wheel which was true and in poise before you started working on the watch? Why not restaff the watch in such a manner that it would not be necessary to put the balance in the truing calipers or on the poising tool? How much time do you waste every day unnecessarily truing and poising balance wheels?

Are you an "escapement expert" who has to reset the pallet stones in every watch you work on because you believe the factory never set the pallet stones correctly in the first place? Do you honestly believe you know more about the escapement than the factory does? Do you know the factory sets pallet stones in a "jig" and that if only one is wrong, then every one is wrong because the pallet stones for all of them were set in the same jig? If the pallet stones weren't correctly set, how did

the factory get the watch to run? How much time do you waste every day resetting pallet stones?

Are you a jasper stone "pivot polish upper" because you believe the balance staff pivots were never correctly polished when the staff was made? If the factory did not correctly polish the balance staff pivots when the watch was made why aren't the pivots of the pallet arbor, escape wheel pinion and all of the other pivots for that matter, improperly polished? Why only the balance staff pivots? How much time do you waste every day jasper stone "polishing" (????) balance staff pivots?

Are you a "tweezer flipper"? Do you flip watch parts out of your tweezers? Why do you do it? Is it you or your tweezers? Why do you not hold on to the part properly with your tweezers instead of deliberately flipping it away across the room? Darned nonsensical we calls it. How many parts do you never find and have to buy a new one? How much time do you waste every day in "tweezer flipping"?

Are you a "floor sweeper upper"? Do you get down on your hands and knees and very carefully go over the floor very minutely and with infinite pains to find something you dropped? Why drop it in the first place? How much money does it cost you (or your boss) to replace parts which you very carelessly dropped? Why do you do it? We formerly worked alongside a fellow in Chicago who used to say: "20 years a watchmaker and 30 years on the floor." Yep, he spent more time on the floor than he did at his bench. How much time do you waste every day as a "floor sweeper upper"?

Are you a pallet arbor pivot "breaker offer"? Does it make you mad when you break the pivot off the pallet arbor of a 210 Gruen or other small watch? Why do you do it? Both pivots were O. K. when you started working on the watch weren't they? Can you set a new pallet arbor, or does it cost you possibly $2.75 for a whole new P. F. & A.? How many times do your break pallet arbor pivots? How much time do you lose when you break a pallet arbor pivot?

Are you a sweep pinion "bender"? If

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you are a pretzel-bender they will pay you good money for doing that work, but your boss won't pay you for bending sweep pinions. Why do you do it? How much time do you lose by trying to straighten sweep pinions and then end up by buying a new one?

Are you a pallet bridge "prier offer"? How many times have you put a screw driver or the point of your tweezers under a pallet bridge to pry it off and then when you assembled the watch after working on it, found the pallet arbor to have far too much end shake? If you tested the endshake before prying off the pallet bridge you found it to be correct. Why did you increase the endshake when you pried off the pallet bridge? You just made yourself some additional work that wasn't necessary in the first place. Why do you do it? How much time do you lose in getting back the correct endshake?

Are you a balance staff pivot "breaker offer"? How many times has your screw driver slipped out of the slot of the end screw (near the balance) of the barrel bridge of an AS976 or other watch? Broke the balance staff, didn't you! Why did you do it? It wasn't necessary you know, it was wholly your fault; not that of the screw, the screw driver or the watch. How much time do you lose putting in a new balance staff in such jobs?

Are you a hairspring "bender upper" or "tangler upper"? The hairspring was all right when you started working on the watch wasn't it? Then why did you "jim" it up? Was it because you didn't have anything else to do, or do you "just love to" reshape, straighten out or untangle a hairspring? You may get a lot of pleasure out of doing such jobs, but we certainly do not. Go ahead and ruin hairsprings, buy a new one. It's the Boss' money you are spending anyhow. Then the customer won't mind waiting until you can get a new hairspring vibrated. How much time do you waste every day doing unnecessary work on hairsprings?

Are you a dial "scratcher upper" or "finger printer"? Perhaps your customer does not object to a scratched up or finger printed dial, but brother, ours sure do. Sure, it will only cost the Boss $1.00 or $1.50 to have the dial refinished and the customer most certainly won't mind waiting for the dial to come back. What about those finger prints on pink dials? Sure look nice don't they? They add so much to the appearance of the dial. Why do you do it? How much money do you needlessly waste in this manner?

Have we gotten "under your hide"? We tried to; believe it or not, we wanted to. Now don't sit there and say you never do any of these things and that we are talking about the other fellow, because you are the very fellow we are hitting at. We hope we made you mad, good and mad and that you are so "riled up" you are going to do something about it. Yep—

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you are going to sit down right now and write that long delayed letter to the Editor giving us "fits up one side and down the other." We hope you do, then we will know if you really had your toes stepped on. If we stepped on enough toes, we will tell you simple ways not to do these things. But if you didn't get your toes stepped on or your feelings hurt, then you wouldn't want to know about these things anyhow, so we won't bother to write out the copy and waste the space printing it.

* * *

How many come-backs do you have every day where the customer complains of the watch stopping when all that was wrong was that the watch had not been properly wound? Many of our customers have said they were afraid of breaking the mainspring or of winding their watch too tight. We have found this to be particularly true in the case of ladies' watches. We have tried explaining that it isn't mechanically possible to wind a watch too tight and the possibility of breaking the mainspring is too remote to even talk about. We have let the power completely down and then had the customer wind the watch for us. When we showed them how much more we could wind the watch they explained they had wound it until it was tight. We have tried all kinds of explanations and demonstrations without too much success. It has been surprising to us how many of these "stopper" come-backs we have completely cured by simply putting on a new crown. Sound ridiculous? It isn't. The thought occurred to us that the crowns on so many watches, particularly ladies' models, are so small and dainty that perhaps they could not properly grasp the crown between their thumb and finger. So we experimented in a few cases by putting on a larger, new crown. Much to our surprise these watches did not come back again as stoppers. We had to call these ladies on the phone to find out if their watches were running because they ceased coming back into the store. When phoned, every one of them said their watch was keeping better time than it had ever done before and had not stopped.

This set in motion some of the wheels in that mental think tank of ours. So we decided to carry our experiment a little farther. From then on we very carefully examined the crown on every watch when we took it in for repair. If it was worn or very small, we suggested a new one. Of course this was done before quoting a price on the job. We found about 75% accepted our suggestion and said to put the new crown on their watch. To those who said they didn't think the new crown was needed, we said no more about it but when the price for the repair job was quoted, the cost of a new crown was included. A few noticed we had put on a new crown when they came for their watch and made mention of it. Of course, it was easy to say the threads were bad, part of the metal eaten away by the salt from perspiration, the gold top was worn off, etc. We said we found it necessary or thought it more advisable to replace the old crown and they could have the new one with our compliments.

We found no further explanation necessary and the customers were highly pleased to believe they had received a new crown free of charge or with our compliments. If we had repaired the watch previous to the stopping complaint, when it came back we simply put on a new crown and said nothing about it. The important thing is that we put on a crown much larger than the old one so they could get hold of it easily when winding.

The most important thing was that we eliminated 90% to 95% of our complaints that newly repaired watches were stopping. Now let us consider this for just a moment from your angle. Did you ever attempt to figure out just how much in actual cash it costs you to handle a come-back? Stop and think for just a minute. There is the cost of the time to stop your work and talk to the customer. The time to look at the watch, the time to write out the tag—and tags also cost money. Then after the customer had left the store, the cost of the time to disassemble and examine the watch, then reassemble it, try it out on the timing machine, hang it on the rack, enter it in your watch repair register, take it off the rack every night and put it in the safe, winding, setting, regulating and putting the watch back on the rack every morning until the customer comes back for it. Then the cost of the time to redeliver the watch to the customer and explain what was wrong. Now figure up the cost of all this time. Could you possibly do it all in half of an hour? We doubt it. How much has it actually cost you to handle this come-back?

You can buy a good grade gold-filled crown (with a solid gold top) for $1.00 a dozen. That is only 8½ cents each. Add to this the time to unscrew the old crown, select a new one and screw it on. Will it all add up to 25c? (We would like to do jobs like that all day long for 25c each.) We know many jewelers who will tell you it costs them not less than $1.00 in time alone to handle a come-back. So why isn't it cheaper to put on a new crown even if you do not charge the customer for it? Try this on some of your stopper come-backs of ladies' watches. You may be surprised at the results. If at all possible always put on a larger crown than was originally on the watch. The idea being that the customer can get a better grip on the larger crown and thus will be more likely to completely wind her watch. It also works just as well with men's watches.

* * *

Do you carry a stock of jewels in settings for watches which use this type of jeweling? We formerly did, but do not now do so. We found we had to carry a very large assortment of hole sizes for many different makes and sizes of watches. We took inventory one day and found we had over 10 gross of set jewels. This put us to thinking. We soon realized what a large investment we had in set and unset friction jewels. The first time we were out of stock of a certain set jewel, we punched out the broken jewel from the setting. Then we chucked up the old setting in the lathe and reamed out the hole in the setting with our friction jeweling reamers, until all of the old jewel shoulder was gone. We thus had a hole straight through the old setting without the usual shoulder for a bezel-set jewel. We then

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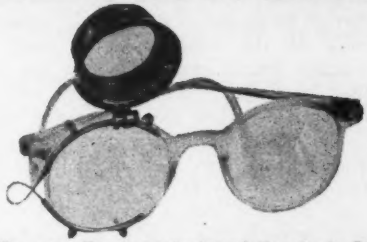

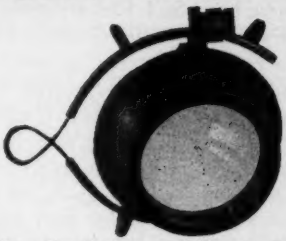

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selected a friction jewel of the right outside diameter to fit the newly reamed hole in the setting and with the proper jewel hole size to fit the pivot. With our friction jeweling tool we pressed the new jewel into the old setting. We now had a new set jewel which we placed in the watch. We started doing this several years ago, thereby gradually using up our old stock of set jewels, until today we do not have one set jewel on hand. Not only have we completely eliminated the investment we had in set jewels, but we have saved money on every set jewel we would have used as the new friction jewels we use do not cost as much as set jewels.

We have added a few sizes of larger outside diameter friction jewels to our stock, because the reamed setting will require a larger jewel than where an original jewel is friction-set into the plate. For hole sizes for the pivots we carry in stock each size from hole 8 to 15. These cover 95% of the jewels we use. Occasionally we have to replace a train jewel where the pivot size is larger than we carry in stock, so we simply order train jewels of the necessary diameter and pivot hole size. Then too, we get quite a few watches for repair where the factory is no longer in existence and we can not secure a set jewel to fit the watch. We have re-jewelled hundreds of such watches where other watch repairmen had told the customer no one could get a part to fit his watch. Anytime you can successfully repair a watch after someone else has told the customer it could not be repaired, you have not only earned the eternal gratitude of your customer, but you have also made an everlasting walking, talking advertisement who will sing your praises to everyone with whom he talks. Try out this idea on the next customer who has a watch with a broken set jewel.

We also have a method of restaffing and putting in new stems in such watches and will be glad to tell you all about it if you want to know. How many times have you handed a watch back to a customer telling him you could not get a staff or stem to fit it and you found out later your competitor down the street had successfully repaired the watch? You sure

lost a customer. Why shouldn't you have made a friend of such a customer instead of losing him? Such jobs are really simple when you know what to do.

We once worked for an employer in Chicago, who, whenever anyone came in and asked for a job as a watch repairman, if the Boss needed another man, he always told the applicant to bring in his tools the next morning ready to go to work. The Boss never once asked a man where he had been working, how long he had been at the bench, what salary he wanted or anything else. He was just told to be in at 8 o'clock the next morning ready to go to work. One could very easily believe from this that the Boss employed a lot of "butchers," "cobblers" and so on, but he didn't. Every man he ever hired was an excellent workman. Sounds incredible, doesn't it?

This is what he did. The next morning when the man showed up for work, the Boss told him to lay out on top of his bench all of his small tools such as tweezers, screw drivers, pliers and so on down the line. Then the Boss took his loupe and inspected every tool. He examined screw drivers to see if they were properly shaped, the ends and sides flat and parallel, not chisel shaped or chipped, each of a different diameter and thickness. Then his work tweezers, hairspring tweezers, etc., examining the points and the insides to see if they were flat and not bellied, the sides flat and at a right angle to the insides, etc. The lathe chucks to see they did not have chipped faces, that they were true, etc., and so on down the line with the rest of the man's tools. If his tools were found to be in good condition then the boss told the man how much he would pay him. If this was satisfactory, he was told to put his tools away in his bench and get ready to go to work.

Never once did we see him hire a poor workman. If upon examination of his tools they were found not to be in good condition, the Boss simply said, "I'm sorry, but I can not use you." Several such men produced excellent references, but the Boss still said he couldn't use them. The Boss went on the theory that if a man's tools were in good condition and properly kept, were of the correct shape, etc., that if the man was careful and methodical enough to do this, that he would automatically do the same with his work on watches. In 15 years we never saw him miss once. It taught us a very valuable lesson. Since then we have never failed to observe a man's tools, even when only visiting with him. We have found our former Boss to be right because every time we have seen a poorly kept set of tools or tools that were in bad condition, we have found the quality of the watch repairing to be the same. Give a good think to this, fellows. It is worth it.

A One-Minute Business Sermon

By Dan Valentino

If I had my way, no owner of a jewelry store would have a private office where he could coop himself up and get away from the customers.

Too many jewelers these days spend their time in back of a closed office door—and not enough jewelers stay out in the establishment, keeping a careful check on the service, saying hello to old customers and introducing themselves to new customers.

In the old days of jewelry selling—no owner of a firm would think of having a customer come in his establishment unheralded. In fact, the old timers kept an eagle eye on the front door, and it was with ceremony and pomp that customers were greeted.

Nowadays, the jewelry business has been wrapped in a cold impersonal blanket. Modern-day jewelry dealers concentrate more on being good businessmen than on being good salesmen.

Yes, I think jewelers have too many private offices these days—they have forgotten how important it is to be the official greeter for the establishment.

Jewelry Repairing

By R. ALLEN HARDY

GENERAL DISCUSSION ON TOOLS

One of the most frequent questions that I hear in my daily contact with watchmakers, engravers and jewelers is, "Which tool shall I buy?" This apparently reflects a confused state of mind due no doubt to the variety of tools presented by various houses, all of them claiming to do the job so well. And "Which tool shall I buy?" is a good question; it is always best to get an experienced viewpoint on any tool or piece of equipment before making an investment.

One of the most important decisions for the jewelry repairman to make is, "Shall I buy a torch or a soldering machine, or both; and if I buy a torch, what type do I want; and if I select a soldering machine, whose design is best?"

First, it is better to consider the entire situation—meaning how much or how little jewelry work do you intend to do; do you intend to attempt all types of work or just ring sizing; do you wish to start doing simple repairs and gradually build the department into a worthwhile part of your establishment.

Generally speaking, if money is to be spent toward equipping a jewelry repair department, then the best possible equipment should be purchased for many reasons. First, good equipment rarely breaks down when needed most. Second, good equipment is almost always the least expensive in the long run, lasting longer and costing less to maintain. Third, good equipment is usually permanent equipment. Fourth, the best equipment is usually the most versatile equipment. Cheap equipment sometimes will not perform the very job it was purchased to perform.

If a flame is to be used, there are many kinds to consider. First, the lowly blowpipe can be used with excellent results, if the shop has a natural gas connection. The blowpipe requires a considerable degree of skill in learning how to efficiently use it, but it has few limitations. It is generally considered to be out-of-date now, and beginners find the effort and energy used up, in learning to use this medium, very discouraging. Oldtimers can do wonders with this simple method of soldering and appear to use up no extra energy or effort.

A fairly new device has been presented to the jewelers within the past few years. This is the gas torch designed very compactly with torch and gas chamber or cartridge all in one unit. This is very handy for a shop not having natural gas connections. One thing should be closely considered before purchasing this type of soldering outfit. Be sure your range of work can be handled with this flame. Jewelers should have access to a very tiny pointed flame that will melt gold or solder platinum. Then there is the acetylene torch to consider. Acetylene has long been used for welding and soldering of all kinds and its efficiency has long been established. The jeweler's acetylene torch reaches a temperature of 2800 degrees Fahrenheit. They can be bought with various size tips which will give from a needle point to a large bushy flame. The tanks can usually be furnished by local hardware stores.

The oxygen-gas torch with pressure gauge is the most expensive and desirable of all soldering outfits since it has no limitations whatever for the jewelry repairman. Desired pressure can be instantly regulated. A wide range of tips covers any job the jeweler might want to solder.

Before purchasing any flame-type of soldering apparatus, it is well to be sure

Mr. Hardy invites your questions pertaining to jewelry repairing. Questions should be directed to Mr. Hardy, c/o The American Horologist & Jeweler, Box 7127, Capitol Hill Station, Denver 6, Colorado. Please enclose a self-addressed, stamped envelope.

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it will do all work expected of it.

Electric arc soldering requires a completely different technique from flame soldering and basically all electric machines work on the same principle. The most modern machines come with either a sliding rheostat or a dial-type rheostat that regulates the heat from zero to a degree high enough to solder platinum. They are not limited and the most important thing to consider is the quality and durability of the machine. Electrical equipment of this nature should be the best to avoid future trouble due to bad connections or failure during the repair of critical jobs.

Polishing motors are important equipment in any shop—be it watch repair or jewelry repair. These motors should be purchased from jewelry supply houses not because the quality of the motor is better than the motors purchased elsewhere, but because they are designed with the jeweler in mind. The height of the motor (above its base), the speed and the horsepower are of primary consideration.

The height of the spindle above the base of a jeweler's polishing motor should be about 7¼ inches. The horsepower should be ¼ plus. The revolutions per minute for a single speed motor should be 3450; for a 2-speed motor 3450 R.P.M. and 1725 R.P.M.

Motors can be purchased with two taper spindles or with one taper spindle and one arbor spindle. These spindles, if damaged or lost, can be easily replaced through your supplier.

We have been discussing polishing motors only. Dust collectors, including motors mounted over dust collecting apparatus, are highly desirable for any shop, most especially the jeweler's shop, for all precious metals polished away during a given period of time are saved in the dust bags. This dust is shipped to the refiners and credit is given for the value of the gold. If enough work is done at the dust collector, this valuable piece of equipment can be more than self-supporting.

Dust collectors can be purchased in various sizes and designs. If space is lim-

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ited, table models with one spindle only can be purchased. The standard type of dust collector is designed with the motor mounted over the dust-collecting apparatus which in turn is located directly over the two dust bags. This has two spindles located over two ducts which lead to the dust bags.

The advantages of the large standard type of dust collector are obvious since they keep the shop clean and the air free from harmful abrasive dust, in addition to the savings earned by refining the waste collected in the dust bags.

The flexible shaft machine is a very handy tool for the jeweler and should be purchased with care as this is very durable equipment that will last for many years, sometimes requiring no attention other than occasional oiling.

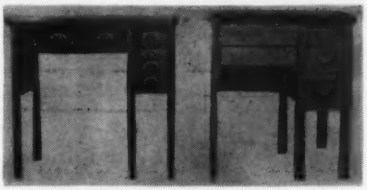
The handpiece is of primary importance. There are two types to consider—the collet type and the Jacobs type of handpiece. While the collet type is very acceptable for general work, the Jacobs type handpiece is recommended for work of greater precision such as diamond setting.

Motors for the flexible shaft machine may be about 1/10 horsepower. They are controlled by a foot rheostat and will provide R.P.M.s of 0 to 15,000. They are usually equipped with a bale for hanging up the machine, saving valuable bench room.

Flexible shaft attachments are too numerous to mention and, of course, are mounted on arbors that are of a diameter easily handled by the collet type or the Jacobs type handpiece.

Most of the smaller hand tools need little or no discussion although there are a few, like the ring shaping pliers that pose quite a problem to the beginner. For instance, there are ring shaping pliers that are shaped as shown in *Fig. 49*. These are a must for average ring sizing work because with these half-round pliers the shank can be manipulated or shaped very

USED
TOOLS AND EQUIPMENT



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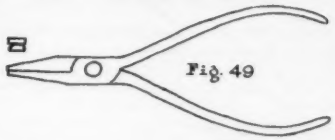

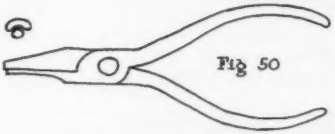

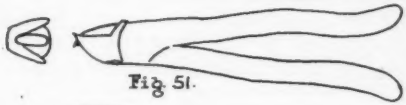

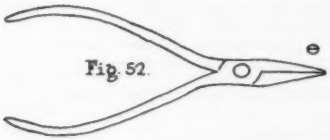

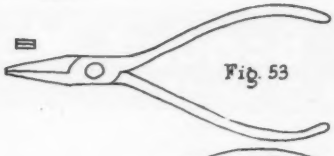

quickly and without marring the surfaces of the shank. Pliers with both jaws flat are incorrect for this type of work.

Another time saver is a plier shaped as shown in *Fig. 50.* This does a job of a more specialized nature as it creates a sharper and more definite bend in the shank. Use care in selecting pliers of this nature. The edge shown should be rounded to prevent marring surfaces.

Another handy plier used in ring shaping is shown in *Fig. 51.* This plier is fundamentally designed to be a bow plier, used for tightening bows on watch cases. The leverage is great on this plier and it will bend and shape the sturdiest shank.

While we are on the subject of pliers, consider the ordinary snipe nose plier. See

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Fig. 52. The jeweler should have two pair of these 4½" pliers to handle a very simple but very important operation—the opening and closing of jump rings, links, etc. Naturally, a fine pointed shape is desired to handle the very tiny rings as well as the larger ones. Due to the slanted position of the two jaws of the pliers (while holding an article) it is sometimes hard to keep the article from flying away since the jaws are smooth and the article highly polished. The answer to this is not pliers with milled or rough jaws. This will, of course, hold the article secure but it will also mar it. The best way to prevent slippage is to secure snipe nose "parallel" pliers—with smooth jaws. This gets into a slightly bulkier tool, but the advantage is manifold.

See *Fig. 53* for flat nose pliers. These are used for many minor operations such as straightening articles, holding articles while they are being worked on, and for general work.

A flat nose "parallel" plier is also a worthwhile tool for it can quickly serve

Fig. 55

Fig. 56

the purpose of a small vise, having the advantage of the twisting and turning positions made possible by holding it in the hand.

End cutting pliers should be about 4½ inches to 5½ inches long and of sturdy material. See *Fig. 54.* Side cutters are just as important because they can frequently make a cut impossible to execute with the end cutters. Round nose pliers need no illustration since they are shaped like the snipe nose pliers with the exception of the inside jaws which are round instead of flat. These are very handy for rounding wire and many shaping operations.

Tweezers are important items that should be very meticulously selected although they are fairly inexpensive (for the

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jeweler). First, the jeweler should have an all-purpose tweezer as shown in *Fig. 55*. As its name implies, this tool is used for picking up and handling almost anything the jeweler comes in contact with. Actually, it is a good idea to have several of these on hand as some may be favored for specific operations, particularly after the points have been reworked a few times.

Soldering tweezers are very inexpensive and it is well to have several of these in different designs — most especially the slide-lock style as shown in *Fig. 56*. These may be 5 or 6 inches long.

Just as the watch maker uses a small bench vise mounted on the extreme right of his bench, so should the jeweler avail himself of this very necessary piece of equipment. The jeweler's bench vise need not be expensive. It should be slightly larger than the watchmaker's vise. This can be used to hold a number of articles while soldering. It is a third hand so to speak, leaving two free hands to hold the pieces (to be soldered) in position until the job is done.

One of the reasons this vise need not be of top quality is because frequently the flame may touch the surface or the heat from the article may travel through sections of the vise. A beautiful finish could be destroyed. Also, during the course of a day, much filing is done and much of it with the aid of the vise. This will soon give the vise a rather battered appearance but does not harm its usefulness. So, bear this in mind when purchasing a vise for the jeweler's bench. It does not have to be the finest.

Next month we will continue with the discussion of tools, equipment and supplies.

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* * *

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uates may be having a tough time finding jobs right now, but it's not true of qualified watchmakers, according to Raymond F. Soucie, director of Elgin Watchmakers College.

Soucie says that for every student who graduates from the school there are five job openings.

"Approximately 100 students graduate from the school each year," he says. "We have between 400 and 500 job openings to fill, in every state of the nation."

The school is operated on a non-profit basis by Elgin National Watch Company. Cost of the 15-month course to the student is approximately $750. It costs Elgin another $750 to teach the watchmakers' craft to each student.

In an effort to meet the growing demand for watchmakers, Elgin has embarked upon a program of expansion and modernization at the college. This includes a new technical library, containing 250 volumes, and a complete revamp of the curriculum.

The new curriculum, says Soucie, was planned to match today's economic, technical and educational requirements. Students are not only taught craftsmanship, but are instructed in what they need to know to help a jeweler operate a successful business.

The basic course now runs 15 months instead of a previous 12. The student starts on filing exercises. He concludes by solving practical problems involving rare clocks, fine watches, automatics and chronographs. Student work weeks are 40 hours long.

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a new, lightweight optical loupe for use on either wire or plastic spectacle frames, adaptable to either right or left side.

The manufacturer states that it can be attached quickly and easily without removing spectacles, and is available in single or double loupes. It is also adjustable for use with single focal or multi-focal lenses and provides maximum flexibility of adjustment to suit any lens requirements.

Behr Manufacturing Company has been identified with watchmaking and optical fields for more than 20 years.

GERMAN CHRONOGRAPH HAS DETACHABLE WATCH MOVEMENT

One of the outstanding technical novelties of the International Watch, Clock and Jewelry Fair held at Frankfurt, Germany last August 21-24 was the Super-Chrono, manufactured by the Hanhart Co. of Schwenningen.

The Super-Chrono is a 17-jewel wrist chronograph with its normal watch movement separate from the chronograph mechanism. The complete chronograph unit is mounted on a ring, and the watch movement is attached to the rim by two screws. The arrangement very much simplifies the repairing of the timepiece.

The chronograph mechanism has been considerably simplified, containing only about a quarter of the number of parts of a conventional model. The Super-Chrono is 35 mm. in diameter, cased, and can be equipped with a calendar disc.

22 MAINSPRING NUMBERS ADDED TO SANDALLOY LINE

Addition of 22 of the most popular mainspring numbers has been made to Sandsteel's line of Sandalloy unbreakable-type mainsprings, bringing the total number available to 34, according to James S. Pasman, vice president of Sandsteel Spring Division, Sandvik Steel, Inc.

Pasman explained that after three years of research and testing, the company is able to produce unbreakable-type mainspring numbers in accordance with the watchmaker's day-to-day needs. He further stated that the first dozen Sandalloy numbers of last spring represented the most popular ones at that time, and that the decision to add 22 numbers was based on the findings of their research department.

Pasman noted that Sandsteel and Sandalloy numbers are interchangeable, both carrying the same catalog nomenclature, with the exception that an "S" is prefixed

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A complete list of Sandalloy numbers is available to watchmakers and jewelers from their authorized Sandsteel distributors or from Sandsteel Spring Division, 145 Hudson St., New York 13, N. Y.

BIRTHSTONES FEATURED IN JIC WINDOW DISPLAY CARDS

Window and in-store display cards, one for each month in the year, showing the birthstone of each month in life-like colors, are now available to jewelers throughout the country as a new and added service of the Jewelry Industry Council.

The new service, according to A. E. Haase, president of the Council, was authorized by the Year-Round Ring Sales Committee, headed by Leonard Shiman, Shiman Manufacturing Co., Newark, N. J., in response to requests from retail jewelers in all parts of the country.

The new birthstone window display, Haase explained, does not displace the Council special birthstone booklet program under which the Council has been making available to jewelers a 16-page four-color booklet called "Romance of Rings and Birthstones" for distribution to the public.

"The Council," Haase stated, "will continue to make new editions of the booklet available to jewelers and will urge jewelers to stir up public interest in the booklet through the birthstone window displays."

Haase pointed out that while a small charge is being made for each set of 12 displays, the birthstone display project would not have been possible without an initial financial underwriting by ring manufacturers and stone dealers.

MODERN TECHNICAL SUPPLY OFFERS RONDA ASSORTMENT

The new Ronda balance staff and stem assortment in bakelite cases is being offered to watchmakers by the Modern Technical Supply Co., 55 W. 42nd St., N. Y. C. The balance staff case consists of an assortment of 800 calibers in trasnparent capsules containing two balance staffs each.

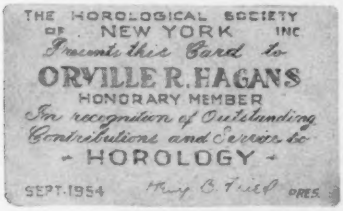
The case measures 5¼" high, 8" wide and 5" deep. The assortment is described as covering all popular makes of watches.

FACTORY REPRESENTATIVE ON TOUR OF SOUTHWEST

Felix M. Buonaventura of San Francisco, factory representative of Fisher-Freeman Automatic Cleaning Machines and sales representative of Kiefer Expansion Bands is currently touring the west and southwest states. He will introduce his products in Houston, Dallas, San Antonio, Denver and adjoining areas.

HOROLOGICAL SOCIETY OF N. Y. SEPT. MEETING REVIEW:

The *Horologist's Loupe,* published by the Horological Society of New York, Ben Matz, Editor, in its October issue carried the following review of its September 1954 meeting:

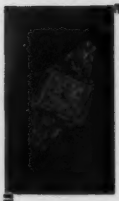


Hagans' Plaque

"Society members had the rare privilege of seeing the presentation of an Honorary Membership. The recipient was Orville R. Hagans, distinguished editor and publisher of the *American Horologist & Jeweler.* The presentation of the silver membership card given in behalf of our Society was made by Barny, whose speech was a charming mixture of eloquence and humor.

"Dr. Rawlings, who has recently returned from Europe, brought with him fraternal greetings from the British Horological Society. We are indebted to him for his fine address.

"Apologies for two big errors in the September announcement of 'The Escapement' film. It was made in London, not Switzerland. It had 3,000 frames per second, not 500.



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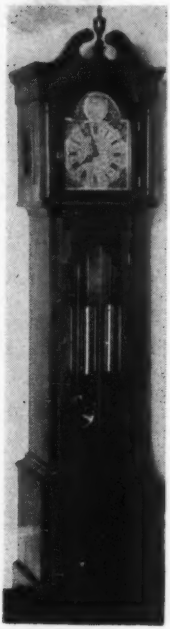
"Attention old members: Any material that you may possess—written, pictorial or otherwise—of our Society's past is needed to aid in the writing of a new history of our Society."



Clock Case Wins Convention Prize

This hand-built grandfather clock case incorporating a German movement won $50.00 first prize for George T. Hogg of Des Moines in a contest sponsored by the Horological Association of Iowa at its annual convention last September 19 held in Des Moines.

A One Minute Business Sermon

By DAN VALENTINE

All merchants — including jewelers — are in the habit of taking an annual inventory of their establishment. They count the stock, the fixtures, the material on hand. An alert, wide-awake businesslike jeweler wouldn't think of not taking inventory.

But how about taking a personal inventory at last once a year?

It would pay any jeweler to sit down some day and take a personal inventory of himself.

He could count his blessings and his faults and he could see how the personal balance sheet reads at the end.

The results would be more than interesting and quite profitable.

All successful business establishments are built on a human foundation. A successful jewelry business just doesn't grow and prosper—it grows and prospers because of the personality of the man behind the business.

You!

That's why an alert jeweler should sit down and take personal inventory of himself now and then, at least as often as he takes inventory of his business and his merchandise.

In this personal inventory a jeweler should count his attitude toward the public and his attitude toward his employes.

He should inventory his attitude toward his business.

He should inventory his personal appearance and his social attitude.

Any man slips in time. It's a human habit.

A personal inventory once a year will help a jeweler become a better business man, a better citizen and a better person!

The following 16 pages numbered 33-48, make up the third sectional insert reprinted from T. D. Wright's great book "Technical Horology."

The 114 pages of "Technical Horology" will be presented monthly in the American Horologist & Jeweler in consecutive 16-page inserts, numbered as the original book pages are numbered.

advance some distance without the wheel, which when it does overtake them will strike the impulse face some little distance along from the locking corner, gradually wearing the points of the teeth. When the inertia of the wheel is so great it is also harder to stop it, the drop on to the locking will be more severe, and the teeth will wear.

Change of motion referred to in the second law does not mean merely change of velocity. A given impressed force acting on two different masses does not produce the same change in the *velocity* of each. If one mass is 100 times as great as the other, the smaller mass will gain 100 times the velocity of the greater one, but the *quantity* of motion is the same in each case. 100 lbs. moving at the rate of one foot per second has the same quantity of motion as 1 lb. moving at the rate of 100 feet per second.

Momentum is *quantity of motion*, and is equal to the product of mass multiplied by velocity. It is always directly proportional to the force that produced it and to the time the force has been acting.

Motion is change of place.

Velocity is rate of motion, and is usually measured in feet-per-second

Velocity is *uniform* when equal spaces are moved through during any equal intervals of time The space passed through will be directly proportional to speed and to the time the body is moving. If v = the velocity, s = the total space moved through, and t = time occupied, then $s = vt$, or $v = \frac{s}{t}$.

If the motion is not uniform, the whole space divided by the whole time gives us the *average* velocity, so that if v then represents the average velocity, the same formulæ apply and $v = \frac{s}{t}$, although the actual velocity at any instant may be different.

When the velocity is *changing* at a *uniform rate*, it may be possible to determine the velocity at any instant.

Acceleration is the *rate of change* of velocity—the velocity gained or lost in one second. Sometimes a losing rate is called a retardation, but it is more customary to call a gaining rate a plus acceleration, and a losing one a minus acceleration.

When the rate of change is the same each second, the motion is said to be *uniformly accelerated.* A body falling freely under the action of gravity is a familiar illustration of uniform acceleration. The acceleration will be + and the velocity will be increasing. If the body be thrown vertically upwards, the acceleration will be uniform during its ascent, but it will now be — and the velocity will be decreasing. When a constant force acts on any body free to move, it gives to that body a motion which is uniformly accelerated. The velocity gained during any given number of seconds will be equal to the acceleration multiplied by the time, that is, equal to the gain each second multiplied by the number of seconds. The space passed over will be equal to the average velocity multiplied by the whole time, and the square of the velocity will be equal to twice the acceleration multiplied by the space. These rules are usually expressed by the following formulæ (a formula is a compact method of expressing a rule).

Let v = the final velocity, s = the whole space covered, t = the time occupied in seconds, and *f* = the acceleration due to any cause, then—

$$v = ft,\ s = \frac{ft^2}{2},\ v^2 = 2fs.$$

When the motion dealt with is that due to gravity, g is used instead of *f*, the rules are identical, but g is understood to mean that particular value of *f* due to gravity. The formulæ so modified then denote the "*Laws of falling bodies.*"

$$v = gt,\ s = \frac{gt^2}{2},\ v^2 = 2gs.$$

g being the acceleration due to gravity, whereas *f* is used to represent the acceleration due to *any* cause.

Suppose the force and the body moved are of such magnitudes that the acceleration produced is 5 feet-per-second, that is, by the end of the first second the velocity acquired will be 5-feet-per-second. If the *force continues to act* a velocity of 5 will be gained every second, and by the end of 10 seconds $v = ft = 5 \times 10 = 50$ feet-per-second, by the end of 14 seconds $v = ft = 5 \times 14 = 70$ feet per second, and so on.

The second expression $s = \frac{ft^2}{2}$ may be shown to be consistent with the statement previously made, that the "space passed over is always equal to the average velocity multiplied by the time." If a body commencing to move from rest gradually and regularly acquires a certain velocity by the end of some given time, its *mean rate* during the whole of that time will be equal to half its final rate, at the end of half the time it would be moving at half the final rate, during the last half of the time it will be moving as much faster than this, as during the first half it was moving slower, and the average velocity during the whole time will be equal to half the final velocity.

The final velocity $v = ft$ $\therefore$ average velocity $= \frac{ft}{2}$, space = average velocity multiplied by time $= s = \frac{ft}{2} \times t = \frac{ft^2}{2}$, *i.e.*, the space passed through by a body moving from rest with uniform acceleration is equal to half the acceleration multiplied by the square of time occupied.

The third expression $v^2 = 2fs$ is an algebraical deduction from the other two, which is useful when we wish to know the relation between f and s without knowing anything about the time occupied.

The "Mechanical Powers" are elementary types of simple machines.

1. The lever. 2. The pulley. 3. The wheel and axle.	Levers.
4. The inclined plane. 5. The wedge. 6. The screw.	Inclined planes.

The laws and principles governing their motion and the transmission of energy by their aid are directly applicable to almost every kind of complicated machine.

It is usual in elementary cases, in estimating the work transmitted by these machines, to neglect the effect of friction. Friction is such an uncertain factor, varying in different machines, and in the same machine under different conditions, that its effect cannot be expressed by any simple law applicable under all conditions. We therefore calculate the possible results from a machine assumed to be mechanically perfect—one that could transmit the whole of the work given to it without loss—and afterwards make such allowance for loss by friction as the particular arrangement may dictate.

The most important mechanical law is that known as the "principle of work."

"What is gained in force is lost in speed."
"What is gained in speed is lost in force."

A machine may be so designed that a force of 1 lb. applied to set it in motion may produce a force of 1000 lbs. at some other point in it, but even if the machine is assumed to be mechanically perfect, the greater force will act proportionately slower, will in the same time only move through a thousandth part of the distance, so the amount of work done is no more. As no machine is perfect, because friction always destroys some of the energy, we should find that at the point that was moving one thousand times slower than the motive power, there would be something less than 1000 lbs. pressure. If the machine were roughly made and badly designed there might only be a pressure of 500 lbs., half the work being lost in overcoming friction. In calculating the possible results we estimate the force we ought to obtain at the working point according to the relative speeds if there had been no friction, and then make an allowance for loss by comparing with similar machines or by direct experiment. A machine designed to increase the "power" at the sacrifice of speed is said to confer a "mechanical advantage," the advantage in the foregoing being $\frac{1000}{1} = 1000$, if a force of 2 lbs. produced a force of 20 lbs., then the mechanical advantage would be $\frac{20}{2} = 10$. Such arrangements are very valuable in presses, stamping machines, lifts, etc., etc., where a great force may be exerted by a weak agent that could not possibly exert it in a direct manner. It must be remembered that mechanical advantage does not mean more work, it is simply converting speed into pressure, the amount of work remaining the same.

A machine designed to increase the speed at the sacrifice of "power" is said to confer a mechanical disadvantage; the definition is not good, because if the machine does what we want, the *advantage* we require is gained. It is better to say that it confers a velocity advantage, the advantage being the velocity of the working point divided by the velocity of the driving point. If a point in the machine moves with one thousand times the velocity of the motive power the velocity advantage will be 1000. Of course, the principle of work applies, and the quick moving part will only exert one-thousandth part of the force (neglecting friction).

Most of the machines selected for illustration in books on mechanics confer a mechanical advantage, the "power" is applied to the quick-moving parts and the work is done slowly with great force. In a clock or watch very little force is required to maintain the motion of a pendulum or a balance, so we invert the ordinary points of application of power and resistance, compel our motive power to move at a very slow rate, and the working points at relatively high speeds with low pressures. The calculations as to relative speeds and pressures are precisely the same as with the more customary form of machine, only we work—from the "mechanical advantage" point of view—from the wrong end of the machine. Of course, it is the right end for our purpose, we obtain all the force we need at the working points, and our motive power only requires its store of energy at comparatively long intervals.

A *lever* is a rigid bar free to turn about a fixed point. The fixed point or axis is called the fulcrum of the lever. A force applied to the lever and tending to turn it about the axis is called the power "P." A force tending to resist the effect of the power, and thus keep the lever at rest, is called the resistance "R" (or Q or W). The tendency of a force to produce, or to resist, rotation, is called the *moment* of the force, it is proportional to the magnitude of the force, and to the direct distance of its line of action from the axis of rotation. Moment = force × leverage. The "moment" of the force tending to turn a lever = P × the length of the arm.

The "principle of the lever" asserts that the forces will balance when the *moment* of P = the *moment* of R. A small force therefore may balance a great one if it has a proportionally longer arm. By making use of the law regarding the moments, we can determine the effect that may be produced at any distance from the axis by a given power acting at a given distance. For instance, a P of 4 lbs. acting at 1 foot from the axis, exerts a force of 2 lbs. at a distance of 2 feet from the axis, and a force of 1 lb. at a distance of 4 feet from the axis; the force exerted will be equal to, and opposite in direction to, the force that acting at that point would balance P, $4 \times 1 = 2 \times 2$, the "moments" are equal. By thus estimating the force that would balance P at any point, we can determine the greatest possible resistance that P can overcome at every point in the lever. Multiply P by its leverage, and divide the product thus obtained by the distance of the given point from the axis, we at once obtain the required force.

Levers are usually divided into three orders:—

1st order—when the fulcrum is between P and R.
2nd order—when R is between the fulcrum and P.
3rd order—when P is between the fulcrum and R.

In the first order P may be greater or less than R, in the second order R is greater than P, in the third order P must be greater than R. The sub-division of the second kind of lever into two orders is confusing and unnecessary. The relative values of P and R are determined in precisely the same way in all three kinds, the only difference between the first order and the others is in the resultant pressure on the fulcrum. In the first kind P and R, acting on opposite sides of the fulcrum, must act along parallel lines in the same direction to balance, and the fulcrum has to bear the pressure due to both forces, therefore pressure on fulcrum = P + R.

In the other kinds, as P and R are both on the same side of the fulcrum, they must act along parallel lines in *opposite* directions to balance, and the pressure on the fulcrum will be equal to the *difference* between P and R.

When the forces do not act along parallel lines the lever is called a "bent lever," the pressure on the fulcrum will then be something greater than the difference between P and R, and something less than their sum, the resultant pressure in any given case may be determined by the "parallelogram of forces." As the pressure is greatest when the lever is of the first order, it is better to select the other

kind (unless in so doing we introduce some greater fault), because the less pressure on the bearing the less will be the friction and wear there.

The lever in an ordinary watch is a lever of the first, second, and third orders, at different phases of its action. When the wheel is being unlocked from the pallet farthest from the balance, the lever is one of the first order. The force at the ruby pin supplying the work is the P, the resistance of the escape wheel to the unlocking is the R, the pivots of the lever staff being the fulcrum between them. In giving impulse by the same pallet it is still a lever of the first order, only now the force exerted by the wheel teeth in giving impulse will be the P, and the resistance at the ruby pin the R. In both cases the pressure on the lever staff pivots will = P + R.

When the wheel is being unlocked from the pallet nearest the balance, the lever will be one of the second order, and when impulse is being given by this pallet it will be one of the third. In these last two conditions the pressure on the pivots will equal the difference between P and R.

A *pulley* is a continuous lever with two equal arms. A single pulley with a fixed axis confers neither a mechanical nor a velocity advantage, it is used to change the direction of a force.

A single movable pulley, such as is generally used to suspend a clock weight, where one end of the line is fixed, confers a velocity advantage = 2. When a system of pulleys is used, the advantage depends upon the arrangement and number of lines, but the relative values of P and R can always be determined by the principle of work, because they will always be inversely proportional to their respective speeds.

A *wheel and axle* is a continuous lever with two unequal arms. A clock barrel with the great wheel turning on the same arbour together form a " wheel and axle," every wheel with its attached pinion forms a " wheel and axle." Although these properly come under the denomination of this mechanical power, we can deal with them as if they were simple levers, the acting radii at any instant being the two arms of the lever. It may be arranged under the first, second, or third order, or as a bent lever, but as in watch or clock work we must always (except in the motion work) apply P at the smaller radius of the axle, and transmit the work by the larger wheel, we seldom use the so-called second order. If a force of 10 lbs. acts along the line at the barrel edge, and the great wheel is twice the size, the force transmitted by its teeth to the centre pinion will be one of 5 lbs. ; as the wheel will describe a circle twice the size of the barrel in the same time, its teeth will travel twice as fast, and the " work " done on the centre pinion will be the same as that done by the weight (neglecting loss by friction). If the centre wheel is five times the size of its own pinion there will be a force of 1 lb. only at the centre wheel teeth, but as the teeth will exert this force through five times the space that the pinion travels through, we again get an illustration of the principle of work. In this way we can take every separate wheel and pinion in the train, calculate the altered forces and speeds at each acting point, and find that at the escape wheel teeth where the speed is greatly increased, and the force correspondingly reduced, there is still the same amount of work done in the same time. As the diameter of a circle is always proportional to its radius, and is usually the easiest to measure, we generally work wheel and axle questions by diameters. P = force at barrel edge, R = force at great wheel teeth, then, P multiplied by diameter of barrel = R multiplied by diameter of wheel. If P be given, and diameters known, then R = P × diameter of barrel, divided by diameter of wheel.

If P be on the opposite side of barrel arbor to the centre pinion, the two arbors being on the same horizontal line, the arrangement is of the " first order," and pressure on barrel pivots = P + R. If the weight hangs between the barrel and centre pinion it is one of the " third order " and pressure on arbor pivots = P — R only. In turret work it is often advantageous to arrange them in the latter way, but in regulators or house clocks the weight in falling would often come so close to the pendulum as to possibly disturb its rate ; this would be a greater evil than the little extra friction created by the first order arrangement, and should be avoided.

An *inclined plane* is a sloping surface by means of which two unequal forces may balance each other.

In an inclined plane the power " P " acts with the greatest effect when its direction is parallel to the plane. Questions on the inclined plane can be easiest

solved by the principle of work. P × the distance through which it moves will be equal to R × the distance through which it moves (during the same time).

Let a weight of R lbs. be resting on a perfectly smooth incline which rises 1 in 10 (the 10 being the distance measured *along* the inclined path). A power P acting parallel to the incline keeps the weight R from sliding down.

If R had to be moved from the bottom of the plane to the top, the work done against gravity would be R × the *height* of the plane. If R is raised by the power P acting along the plane, P must travel the whole *length* of the plane (10) to raise R to the height (1).

The work done by the power = P × 10, the work done on the weight = R × 1 = P × 10, $\therefore$ $P = \frac{R}{10}$ or P : R : : 1 : 10.

If R weighed 100 lbs. a force of 10 lbs. would keep it at rest.

Whenever R acts in a direction parallel to *height* of plane h, and P acts in a direction parallel to *length* of plane l, then Pl = Rh : $P = \frac{Rh.}{l}$

This applies to all fixed planes such as railway inclines, hill paths, etc., etc., where gravity is the vertical force and the weight has to be raised by a power acting along the inclined path itself.

When the plane is movable the conditions are altered but the reasoning is the same. Calculate the distances through which P and R would respectively move during the same time, and we then know their forces will be inversely as these distances. Let the plane be free to move horizontally without friction, let h = height of plane, and b = the length of its *base*, let P be a force acting horizontally, and R a vertical force (such as a weight moving in guides so that it can only move straight up and down, and resting against the plane) tending to push the plane backwards against P. If R is raised from the bottom of the plane to the top by P pushing the plane along and underneath R, the work done by P = P × base of plane, the work done against R = R × height of plane. If R now moves back again down the plane, it must push the plane backwards against P, and the work done against P = P × base, while the work done by R = R × the height, and the conditions of equilibrium are expressed by Rh = Pb or P : R : : h : b $\therefore$ $P = \frac{Rh.}{b}$ P thus represents the force that would keep the weight at rest, and prevent it from pushing the plane backwards by passing down it. As two equal forces acting in opposite directions along the same line balance one another, P also represents the force with which the weight is tending to move the incline (against the direction of P). If height of plane be 2, and length of its base 5, R being a weight of 10 lbs., then $P = 10 \times \frac{2}{5} = 4$ lbs.

The weight of 10 lbs. is tending to move the plane with a force of 4 lbs., and a force of 4 lbs. acting in the direction of P would keep it at rest.

The escape wheel tooth of a cylinder watch represents such a plane, P being the tangential force exerted by the wheel, and R being the resistance offered at the cylinder edge against the tooth. The formulæ give the conditions of equilibrium; for the watch to go, P must be greater, or it would "set" on the impulse. If the height of plane is greater than the length of its base, P will be greater than R; usually in an escape wheel height is much less than base.

The directions of the forces are not necessarily vertical and horizontal, they may be in any different directions, but the principle of work will always give us their greatest possible respective values if we know the directions and the inclination of the plane to them. The impulse planes in the pallets of an ordinary clock or a lever watch, are similarly inclined planes.

The *wedge* is a movable inclined plane; the name wedge is only usually applied when motion is produced by a blow, under which condition it is seldom used in horology.

The *screw* is an inclined plane wrapped round a cylinder; it is seldom used as a mechanical power in horology. One may find it occasionally in old-fashioned verge watches where an endless screw is used to set up the adjustment of the mainspring. The screws used to keep the parts of a watch together are not used as mechanical powers, they do not transmit motion; we simply make use of their friction to prevent motion.

Friction is that resistance to motion which is experienced when two rough surfaces are moved upon one another.

Friction is always opposing motion at the point where it is acting; is greater between some materials than others, and greater when the surfaces are rougher. It is not possible to make any surface *perfectly smooth*, so we always find some resistance due to friction when any two surfaces are moved over one another.

The laws relating to friction between solid surfaces are stated as follows :—

1. Friction is proportional to the total pressure between the two surfaces.
2. Friction is independent of the areas of the rubbing surfaces.
3. Friction is independent of velocity.

When a solid body moves in a liquid the resistance met with is called fluid friction, and the laws governing its effects are different, being stated as follows :—

1. Friction is independent of pressure.
2. Friction is proportional to the area of the wetted surface.
3. Friction is proportional to velocity at slow speeds, but increases at a greater rate than the velocity when the speed is high.

When a thin layer of oil or other lubricant is introduced between the surfaces friction is reduced, the oil is split up, as it were, into minute rollers separating the surfaces and aiding motion. In machinery generally the lubricant lessens the friction, but the results are still governed by the laws of solid friction. This is also probably the case at nearly all the rubbing parts of a clock or a watch. At the balance pivots of a watch, however, where the pressure is small, the velocity slow, and the quantity of oil comparatively large, it is possible that the effects of fluid friction or adhesion are quite as potent as those of solid friction, and that the results are a modification or compromise between the two sets of laws.

Judgment is required in selecting a lubricant adapted to the pressure at the rubbing points. When the pressures are great a comparatively thick oil is necessary, a thin one would be squeezed out. Where the pressures are very small a thin oil is required. By using a very thick oil to the balance pivots of a small watch the adhesive resistance might almost be sufficient to stop the watch.

The force with which friction resists the motion of one surface over the other is found to be equal to the force pressing the surfaces together multiplied by a number which is found by experiment. This number—it is always a fraction—is called the *co-efficient of friction*. It may be found experimentally as follows :—

Suppose we wish to determine the co-efficient of friction between brass and steel of a definite degree of smoothness. Fix a plate of brass of the required smoothness perfectly horizontal, on it rest a slide of the steel similarly smoothed on its under side, rest weights on the slide, and over a pulley fixed at the end of the brass shelf or plate pass a cord having one end fixed to the slide, the other terminating in a scale pan, in which you place weights sufficient to just keep the slide in motion on the plate. The pressure between the surfaces is equal to the weight of the slide itself together with the weights placed on it, the force of friction is represented by the weight of the scale pan and the weights in it, which together have just overcome the friction. Suppose the weighted slide is exactly 7 lbs., and the pan with its weight is just 1 lb., then the pressure is 7 lbs., and the force of friction 1 lb. If we now increase the weight of the slide to 14 lbs., we shall have to increase the weight of pan to 2 lbs., and we find that in the same proportion as we increase the pressure so the force necessary to overcome friction will be increased, thus proving the truth of the first law, "the force of friction is directly proportional to the pressure." With these two materials, so long as the smoothness of their surfaces remains unchanged, we find that the ratio between friction and pressure remains constant. The co-efficient of friction states the ratio in the form of a fraction, the force of friction being the numerator and the pressure being the denominator. In the foregoing example the co-efficient of friction $= \frac{2}{14} = \frac{1}{7} = .143$, and when we have determined this ratio we know that whatever the pressure may be we can determine the force of friction by mutiplying the pressure by the co-efficient. In this particular case the force with which friction is resisting motion is equal to one-seventh of the force of the pressure between them. Brass and steel surfaces as finished in ordinary machines have a co-efficient of friction averaging .14, therefore if the pressure = 100 lbs., the force of friction = 100 × .14 = 14 lb., if pressure = 12 lbs. friction = 12 × .14 = 1·68 lbs., and so on.

Read the articles, in some standard work on Mechanics, on the foregoing subjects.

Friction between a pivot and its bearing is a resisting force acting at the circumference of the pivot. As it is directly proportional to the pressure there we should arrange the train, as far as may be practicable, under such " orders " as tend to reduce the pressure.

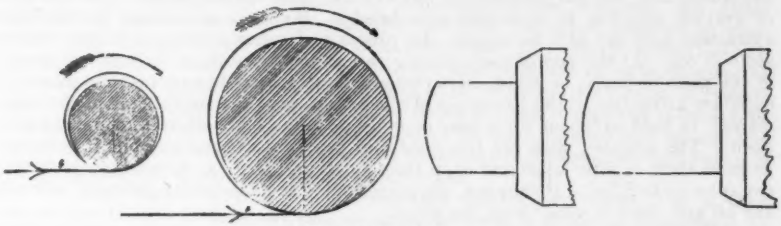


FIG 12.

Altering the size of a pivot does not alter the *force* of friction if the pressure and the nature of the surfaces remain the same. If we use a very short pivot, although the total pressure, and therefore the total friction, remains the same, the pressure is distributed over a very small area, therefore the *pressure per square inch* is increased, and both pivot and bearing wear quickly. If we use a very long pivot the pressure per square inch is less, and there is less tendency to wear, but as the pivot has to be oiled, the effects of adhesion would be greater. In altering the diameter of a pivot although we do not change the force of friction we do alter its effect. The same force acting at the circumference of a large pivot has a greater checking effect than when acting at the circumference of a small one. The effect of friction, or the " moment of friction," is directly proportional to the diameter of pivot. Considered as a question of " work," the same result appears. At each complete rotation the work done against friction = the force of friction multiplied by the distance round the pivot—that is, by the circumference, as this is always proportional to the diameter we find that the effect of friction varies directly as the diameter of pivot, but is not changed by altered length. Effect of adhesion, considered apart from the effects of solid friction, varies directly as area of surface exposed to its action. It is, therefore, proportional to length, and to diameter of pivot.

Although not applicable to every case, it is a fairly good general rule to make the diameter of pivot as small as is consistent with the necessary strength, and have the acting length equal to the diameter. Friction at all the rubbing parts of a machine is productive of wear, and " dissipates energy " ; we can never do away with it entirely, but we do aim to reduce its effect as far as may be practicable, and also endeavour that its influence shall remain constant.

Let f = the force of friction, P = the pressure of the pivot against its bearing, μ = the co-efficient of friction, then $f = P\mu$.

Let d = diameter of pivot, and N = the number of rotations it makes. The distance of rubbing per turn = the circumference of pivot = $d\pi$, and the work done against friction during N turns = $P\mu d\pi N$.

In some ways friction renders valuable assistance ; the parts of a machine would not hold together if it were not for friction. Suppose we could make an ordinary three-quarter plate watch of some *perfectly frictionless* material, as we turned it about the hands would fall off, the cannon pinion and set-hand arbor drop out, the pallets and lever turn on their staff, all the pins would fall out, and the screws come out of their holes, for their own weight would cause them to roll down the " inclined planes " and drop out. All these things are kept in their proper positions by friction.

Capillarity is that attractive property that causes liquids to rise in small tubes, or between plates that are close to one another when the liquid is of such a nature—as oil or water—that it wets solid surfaces.

If we place a small tube in oil or water the liquid will rise inside the tube above the level of the surrounding liquid, it will rise higher the smaller the tube is, its surface will assume a concave form, rising highest where it touches the side of the

tube. It will also rise up the outside of the tube in a similar way, but not so high as it does inside. If we place two plates of glass or metal in the liquid, two of the vertical edges touching, the opposite edges being separated a short distance, the liquid will rise between them in a hollow curve, highest where the plates are closest.

Take a sheet of blotting paper, or a piece of salt, and hold one edge in a vessel containing ink, capillary attraction will at once cause the ink to overcome the pull of gravity and rise to a considerable height. We take advantage of capillary attraction and are able to supply our pivots and other rubbing surfaces with a store of oil. At the end of each pivot a saucer-shaped sink or " chamfer " is cut in the plate or jewel, in which oil is placed ; from this little reservoir the pivot by capillary attraction draws its supply of oil as required. The oil sink should be large enough to hold sufficient for a year or two—as long as the oil will keep clean and good. The adopted sizes are the results of practical experience, but it is better to have them a little large and deep than small and shallow, because they should never be quite filled. If they are, the surrounding surfaces of the plate will attract the oil and draw it away from the pivot.

Oil will easily be drawn away from a shoulder by any larger surface that is very close to it, but it does not easily turn round sharp corners. If a staff is tapered to the shoulder the oil might be attracted up the staff away from the pivot, so we turn back-slopes or nicks immediately behind the shoulder, and then, unless we apply far too much oil, there will be no tendency to pass over the sharp corner thus formed and leave the pivots. With pivots that are very close to the pinions, as the centre or third lower pivots, we turn undercut hollows behind the shoulders for the same purpose.

With a dry liquid like mercury, which does not wet the solid, we get capillary action, but it is then a repulsion, not an attraction, it is repelled most where it touches the tube, and the surface becomes convex.

PROPERTIES OF METALS.

For definitions of elastic properties see previous notes, page 22.

Iron is an elementary body of great tenacity and toughness, capable of being welded at a white heat. It is not used in watch-work in its simple form, but it is used in large clocks. Its quality may be judged by the fracture—if good it is characterised by long twisted fibres of a brilliant white colour.

Steel is a combination of iron and carbon, containing about one per cent. of carbon. It is prepared in various ways, but good cast steel is considered best for most horological purposes. Its fracture should be smooth, compact, and of a white-grey colour resembling coke. After hardening it can be highly and uniformly polished, but care must be taken not to heat it too much or it will be deteriorated. It should not be heated beyond a cherry red or it may become " burnt."

Cast iron is, like steel, a compound body consisting of iron and carbon, but contains a larger proportion of carbon than steel does. The proportion varies, but it usually contains from two to five per cent. of carbon. The carbon acts as a flux and renders the metal fusible, so that excellent castings can be made. It offers great resistance against crushing, and is valuable for many parts of large clocks, but it is not easily workable, and therefore is not good for pieces that need to be turned true or filed.

Copper is an elementary body of great toughness, and ranking next to iron for tenacity. It is not much used in horology except when alloyed with other metals. It is used for the plates and feet of watch dials, because its expansion is about the same as the enamel used, which therefore does not crack in cooling.

Zinc is an elementary body neither very tenacious nor tough. It melts at a comparatively low temperature and enters into the composition of many alloys. It is used in its simple form for the tubes or rods of compensation pendulums and sometimes for the bobs of pendulums.

Brass is an alloy of copper and zinc containing about two parts of copper to one of zinc. The addition of about one per cent. of lead imparts a degree of brittleness that makes it easier to turn and file. If a portion of the lead is replaced by tin the metal becomes more malleable. It is invaluable in horology, being far more useful than either copper or zinc alone. It is easier to turn and file, and harder than copper ; it is not so brittle as zinc.

Aluminium bronze is an alloy of copper and aluminium. The best proportion for horological purposes has been found to be nine parts of copper to one of aluminium ; it is harder and more durable than brass, and is used for the lever, roller, and pallets of non-magnetisable watches. It is a good material to use for the escape wheels of lever watches.

Palladium alloys have been very largely used of late years for balance springs and for the compensation balances of non-magnetisable watches. No other material has been so successful for the latter purpose. It is not affected by magnetism and does not rust—two valuable properties. Its elastic properties are inferior to those of steel, and, like many alloys, there appears to be an element of uncertainty in its composition, and especially in the constancy of its elastic properties. For a high-class adjusted watch not liable to come under the influence of magnetism there is no doubt that steel is better for both balance and spring, but where the wearers of watches are frequently within the influence of electric currents palladium alloy is, so far, the best material to use.

Dr. Guillaume's nickel-steel, commercially known as "Invar," is a very remarkable alloy. It does not rust so easily as steel, it is not so susceptible to magnetism, but its most remarkable characteristic is that, when mixed in certain proportions, it is almost insensible to changes of temperature. When the proportions are about 36 per cent. nickel and 64 per cent. steel the co-efficient of expansion is extremely small ; some specimens have been produced having no apparent change within fairly wide ranges of temperature, and I am informed that some have even a minus co-efficient. It is valuable for the balances and balance springs of watches, and for pendulum rods. Compensation balances of this material have been very successful, but, as with palladium alloy, there is some uncertainty, and every specimen must be tested. Balance springs for high-class watches have not been so successful, as there appears to be some uncertainty and irregularity, but for the everyday watch of commerce, the temperature error is to a large extent eliminated.

If steel be heated to a red-heat and then suddenly chilled it becomes very hard and brittle. The degree of hardness imparted to it depends upon the nature and temperature of the material into which it is plunged. If plunged in oil or tallow it will be too hard to file, but will retain some degree of toughness and will not be excessively brittle. If plunged in cold water it will be harder and more brittle. Salt water, sulphuric acid, mercury, nitric acid, and cyanide will make it respectively harder and more brittle. Drills and cutting tools to be used on soft steel may be hardened in oil or tallow and used without tempering. If required for low tempered steel they may be left hard from cold water, and if required for harder steel they should be hardened in one of the other materials according to circumstances. Hard steel would be too brittle to use for springs, pinions, screws, or pieces liable to be subjected to bending strains. If hardened steel be re-heated it will become "tempered" and lose its brittleness, the degree of temper depending upon the amount of heat imparted to it. If heated to a red-heat and allowed to cool gradually it would become as soft as before it was hardened. The degree of temper is perhaps best judged by observing the change of colour that the steel undergoes during the process of re-heating ; the film or scale produced on the surface in hardening being first removed with an emery stick or some similar cleansing appliance. When the clean hard steel is heated to a temperature of about 430° F. it begins to turn of a pale yellow colour, as the heat increases the yellow becomes deeper in tint until it is almost brown, merging into a purple, which grows darker and darker until it becomes dark blue (570° F.), the blue grows pale until it fades away into a greenish grey, after which no further change of colour is observable.

Soft steel will undergo similar changes of colour if heated, and steel tempered to a light blue may be cleaned again and re-heated to a yellow, which colour it will retain when it grows cold. One must not assume, therefore, that every piece of coloured steel that is met with is necessarily tempered, as soft steel is sometimes heated to a desired colour to give it the appearance of tempered steel. When you *know* the steel to be hard before it is tempered, you may rely on the colour as a good indication of the temper.

Steel has its maximum elasticity at one of the blue tints. Pinions, arbors, and springs should be tempered to a blue, rather light than dark, to avoid danger of brittleness. Screws may be even softer, or the heads may come off in screwing

them home. Many watchmakers temper screws by boiling them in oil until the oil catches fire, or by "flaring"; this corresponds in temper to a pale blue.

When steel has to be worked it is often advantageous to "anneal" it; this consists in making it as soft as may be without destroying any of its characteristic properties. The best way to anneal steel is to heat it gradually in a slow fire to a red-heat, and then allow the fire to go out, leaving the steel in the ashes until they are quite cold. It may also be annealed, although not quite so effectually, by heating it to a very dull red—not quite so hot as would be required to harden it—and plunging into cold water. This is a very good plan when the annealing has to be done quickly, and will make the steel soft enough for most purposes, soft enough to cut the teeth in keyless winding wheels. When the piece is finished to shape and size it can then be hardened and tempered. If it has had to undergo bending and twisting, or is of a complicated shape of uneven thickness, it will be wise to gently heat it to a blue colour before hardening, to "set" it to its final form. Brass cannot be hardened by heating and chilling. The best way to harden it is by careful hammering. It may be annealed in a similar manner to steel.

Case hardening is a process by which the surface only of a piece of iron is converted into steel. It is heated to a red-heat in some material containing carbon, and cooled by immersion in water.

Tenacity is that property that causes a material to resist rupture, and is a measure of its "breaking strength."

Toughness is that property that permits of a material being bent and twisted, backwards and forwards, many times without breaking. Pure wrought iron and copper are both very tough.

Malleability is the property that allows a metal to be beaten out into thin sheets. Gold, silver, tin, and lead are very malleable.

Ductility is that property that permits of a metal being drawn into very fine wire. Gold, silver, iron, and copper are very ductile.

If a metal is tenacious as well as malleable it will also be ductile. If it is malleable but has little tenacity, as tin or lead, it will not be ductile, because it will break with the strain necessarily put upon it in drawing.

Most materials expand and contract with changes of temperature.

The co-efficient of expansion is a number representing the *fraction of its own length* that a body will expand or contract for a given change of temperature. Three temperature scales are in use in different countries: the Fahrenheit (F.), the Celsius or centigrade (C.), and the Reaumur (R.).

On the Fahrenheit scale the temperature of melting ice is marked 32°, on each of the others the same temperature is marked 0°. Therefore the reading 32°F. = 0°C. = 0°R. = the "freezing point." On the Fahrenheit scale the temperature of boiling water is 212°, on the centigrade it is 100°, and on the Reaumur 80°. Therefore the "boiling point" = 212°F. = 100°C. = 80°R.

Between the freezing and boiling points there are 180°F., 100°C., and 80°R., a range of 9° on the F. scale = a range of 5°C., and a range of 4°R.

In many books on the subject of "Heat" tables may be found giving the results of careful experiments, made for the purpose of determining the relative expansions of different materials. In making use of these tables for comparative purposes care must be taken to use co-efficients for equal ranges of temperatures. As within certain limits, and with a few remarkable exceptions, the change in dimensions is always proportional to the change of temperature, it is easy to convert the value of the co-efficient for one scale to its corresponding value on another scale.

1°C. is merely a wider range of temperature than 1°F., in the proportion of 9 to 5. If the co-efficient of expansion for iron per 1°F. = ·000006 then the co-efficient per 1°C. = $\frac{\cdot 000006}{5} \times 9 = \cdot 000012$, and the co-efficient for a range of temperature from freezing to boiling point = ·000006 × 180 = ·000012 × 100 = ·0012. An iron rod one foot long at a temperature of melting ice would become 1·0012 feet long at the temperature of boiling water; if the rod were 5 feet long each foot would be equally lengthened, and the new length would be 5 feet + ·0012 × 5 = 5·006 feet.

The lengthening is equal to the co-efficient per 1° multiplied by the number of degrees, multiplied by the length of the body. In calculating the relative lengths of metals required for compensation pendulums we have only to deal

with proportionate values, so it does not matter in the least what range of temperature we have the co-efficient for, so long as it is the same range for each metal.

Steel has two objectionable qualities, it is liable to rust and to become magnetised. These faults may seriously affect the rate of a watch. If rust attacks the pinions, or springs, or parts of the escapement of a watch, there is no cure —the old pieces must be discarded and new ones substituted. Experiments have been made with steel to render it rust-proof, but the best preventive is to take care that the watch is never exposed to the danger of becoming rusty. I am told that it is a good plan to lightly paint all the steel work with raw linseed oil, using a camel-hair brush. The oil quickly dries. It has been used for turret clocks, and for the balance springs of marine chronometers.

The parts of a watch are liable to become magnetised if the wearer ventures very close to the machinery used in electric lighting or to any other powerful source of electricity. Unless the balance, balance spring, pallets, lever and roller, or other quick-moving parts of an escapement are made of some material not sensibly affected by magnetism, the time-keeping properties are destroyed until the magnetised pieces are deprived of their magnetism. The most satisfactory and easiest method of demagnetising a watch, at present known, is to place it—complete, in its case—for a few seconds inside a coil of wire (a solenoid), through which an *alternating* current of electricity is passing. The watch must be removed slowly *while the current is flowing*, and it will be completely demagnetised.

The demagnetising coil should be placed with its axis in a horizontal line at right angles to the magnetic meridian, so that the watch in passing through the coil moves in a straight line at right angles to the compass needle. It should be withdrawn along this line until it is several feet from the coil *before the current is switched off*. With the modern coils of very fine wire the current should be switched off directly the operation is completed, as the wire gets hot very rapidly and would soon spoil.

FUSEES AND MAINTAINING POWERS.

A fusee is an axle of varying radius attached to the great wheel arbor of a watch or a spring clock; it is so shaped that the "moment" of the varying pull of the mainspring shall remain constant in its tendency to turn the great wheel round. When the spring is fully wound and the pull strongest, the chain or line acts at the smallest part of the fusee (works with a short lever). When the pull is weakest it acts at the largest part of the fusee. The form of the fusee is so graduated that the product of force multiplied by acting radius is the same throughout. The geometrical form of a fusee is a hyperbola.

The effect of using a properly shaped fusee in a spring clock or a watch, is to produce an unvarying force at every acting part of the train, and therefore an unvarying force of impulse to the pendulum or balance. With the better forms of escapements in modern use it is found possible to obtain an almost perfect rate of time-keeping with a motive power that does vary, but by using a fusee and thus equalising the effect of the motive power, we do get rid of a possible source of error. No fusee is needed in a weight-driven clock, because the force exerted by the weight is always the same.

To ascertain if the form of the fusee is correct for the mainspring, an "adjusting rod" is used. This is a lever with adjustable jaws for gripping the fusee square, and carrying a sliding weight, which may be fixed anywhere along the lever. The barrel and fusee are placed in the frame, the chain put on, and the mainspring wound, say, half a turn, by the barrel ratchet and click work. The rod is fixed to the fusee, which is wound up a short distance, and the weight is adjusted along the lever until the turning moment of the mainspring is balanced by the turning moment of the weighted lever. The chain is then wound on to the fusee and allowed to unwind slowly by shifting the weight a little nearer the centre of motion, noting the pull all the way down. If the pull is greater when fully wound than at the bottom turn, the spring must be "set up" more, *i.e.*, wound up more at the barrel arbor; this strengthens the bottom pull much more than it does the top ones. If the bottom pull is stronger than the top one, the spring must be "let down" at the barrel arbor. If, when the top and bottom pulls are equal, the pull at the middle turns is greater, the fusee must be re-cut smaller in the middle. When a new mainspring is fitted, the adjustment must always be tested.

An adjusting rod is useful with a going barrel in setting up the stopwork.

When the spring is quite down there is no pull from it, when it is wound tight round the arbor the pull is excessive. A stopwork enables us to cut out the very unequal parts. By fixing an adjusting rod on the barrel arbor square one can determine the amount of setting up required to place the stopwork in the position where the difference between the pull at the beginning and the ending of the winding varies least.

When we wind up a weight clock, or a watch or clock that has a fusee, the act of winding tends to reverse the motion of the train, and unless some provision is made, the machine will either stop, or travel backwards some distance during winding.

The *maintaining power* is an arrangement designed to keep the machine going during the time of winding.

The earliest form of maintainer was Huyghen's endless cord. In this the weight is ingeniously suspended in such a way that its pull on the going train is in no way interfered with in the act of winding. The weight itself is the maintaining power (see Britten or Becket).

Harrison's maintaining power is the one most generally used in modern watches and clocks. For a full description of this and others see Britten's Handbook.

In most maintaining powers a supplementary spring is wound up a short distance by the pull of the driving weight or spring, and remains so wound during the going of the watch or clock. In the act of winding the maintaining spring is freed of the strain that wound it, and endeavours to return to its original form. But the end of it that was drawn forward cannot go backward, because at that point it is attached to the large ratchet, which is prevented from rotating against the going direction by the pivoted click, called a detent, that acts in its teeth. The forward end being thus held, the spring unwinds itself by drawing the other end round; as this end is attached to the great wheel it drives the great wheel in the going direction until the maintaining spring has resumed its original form, which would not occur until after a longer period than the time necessary to wind the watch or clock up. Directly the winding ceases, the mainspring draws the maintaining spring forward ready to come into action again as soon as the key shall be turned in the direction of the winding. For the maintaining power to act properly it must be weaker than the mainspring or it will not be wound up; so long as it is weak enough for this to be certainly done it should be as strong as possible. If the spring is too weak, and the fusee is pinned up too tight, it may not be able to overcome the friction of the various parts. The detent must be properly pivoted and planted, and its point well shaped to remain constantly in action with the large ratchet. If from any cause the detent fails to hold the ratchet firmly during the act of winding the maintaining power will fail.

GEARING.

If two plain discs, perfectly true on their centres, having their edges roughened to prevent slipping, were planted so that their circumferences just touched, they might communicate motion to one another perfectly and without loss of energy. If there were no slipping at the point of contact there would be no friction there. The linear velocities of the circumferences would be equal throughout; when one inch of one circumference had passed the point of contact one inch of the other would have also passed it; when one-hundredth of an inch of the one had passed, one-hundredth of an inch of the other would have passed, and so on throughout their entire motion points in the circumferences of each would travel with equal speeds. If the motion of one was uniform, so also would be that of the other. The angular velocity, or rate of rotation of each, would be inversely proportional to their respective circumferences (or diameters).

If the one is two inches round, and the other one inch, the smaller one must make two turns while the larger is making one, because the actual speeds of their circumferences are equal. If the motion of the disc that was driving remained perfectly uniform throughout, so also would that of the follower (the one that was driven, or led), and this would be true whether we were considering whole rotations or small fractional parts. We should then say that the "lead" was uniform.

In practice we find it impossible to make and keep such discs perfectly true. If they remain true enough for a time they have to be pressed together with such force that the friction and wear at the pivots is excessive, and there is always some

danger of slipping at the contact surfaces. If *any* slipping occurs the follower is left behind, and in machines like watches and clocks, where the relative motions of the parts must be absolutely maintained, such means of transmitting motion would be useless.

We therefore add projecting points to our discs and cut spaces for them to work in so that there shall be no slipping. In doing so we endeavour to so form them that the relative motions shall be identically the same as if they were two true smooth discs rolling perfectly together without any slipping.

The intersection of the teeth of two cut wheels is called the " depth."

The depth is correct when the two wheels are at such a distance apart that if they were smooth discs without teeth their circumferences would just touch. The circles that the toothed wheels would occupy if they could be used without teeth are called their " pitch circles." The " pitch " is the distance from one tooth to the corresponding point in the next—therefore including a tooth and a space—measured along the arc of the pitch circle. The pitch equals the circumference of the pitch circle divided by the number of teeth. This is called *the circular pitch*. Another method of expressing the pitch, often used, especially in America, is called *the diametral pitch*. If a wheel has 60 teeth and a pitch diameter of 1 inch the diametral pitch = 60P, meaning that wheels of any size, of this pitch, will contain 60 teeth to every inch of the pitch diameter. If we divide each inch of the diameter by the number representing the diametral pitch we obtain a fraction, sometimes called the *module* (see a " Practical Treatise on Gearing," by Brown & Sharpe, of Rhode Island, U.S.A.), bearing the same relation to the pitch diameter as the circular pitch bears to the pitch circumference. Therefore the module multiplied by π = the circular pitch, or the circular pitch is obtained by dividing π by the number representing the diametral pitch.

The number of teeth in any wheel multiplied by the module of the pitch equals the pitch diameter. The distance of centres of any pair of wheels gearing together is equal to the sum of their pitch radii. Add together the numbers of teeth in the two wheels, divide the sum by two, and multiply by the module, the product is equal to the distance of centres. For two wheels to gear properly together they must be of equal pitch, therefore the sizes of their respective *pitch circles* must be directly proportional to the numbers of teeth required. The *measured* diameters of toothed wheels will not be in that exact proportion (except when the wheels have equal numbers of teeth). When a large wheel drives a small pinion (a wheel is usually called a pinion when it has less than 20 teeth) the points added beyond the pitch circles, and called the " addenda " of the teeth, add proportionately more to the pitch diameter of the small pinion that they do to the large wheel. The increase will be greater as the difference in the numbers of the teeth and leaves is greater, and will vary according to the form given to the rounding of the pinion leaf.

In almost all gearing the spaces between the teeth of a driving wheel are equal in width, at the pitch circumference, to the width of the tooth. The width of the tooth, therefore, equals half the circular pitch. In most engineering work the whole of the geometrical addendum is not required, as the next tooth has taken up the lead before the one in front has worked to the tip. In such cases it is usual to add to the pitch radius an amount equal to the module to obtain the working radius. The measured diameter of such a wheel = the pitch diameter + twice the module, and to watch and clock-makers it looks like a wheel that has been " topped " and not rounded up afterwards. The tips of the teeth are not really required.

In watch and clock work, where the ratio of the number of teeth in the wheel to the number in the pinion is large, it is usually advisable to retain the whole of the addendum right up to where the two curves meet in a point at the middle of the tooth, the measured diameter then = pitch diameter + circular pitch.

The driven pinions of watches in many cases have semi-circular roundings. During the arc of contact after the line of centres the action is entirely taking place between the addendum of the wheel and the flank of the pinion. During the comparatively small arc of contact before the line of centres, the small part of the rounding of the pinion really engaged is so little different to the true geometrical form that the difference is unimportant, especially in the higher numbered pinions, and semi-circular roundings can easily be correctly reproduced, whereas it is extremely difficult to accurately reproduce the true curve in a small watch pinion.

If, as is commonly the case, the width of the pinion leaf at the pitch circumference is equal to one-third of the circular pitch, the height of the addendum beyond the pitch circumference is equal to one-sixth of the pitch, and the full diameter will be equal to the pitch diameter + one-third of the pitch.

When the pinion has to drive the wheel semi-circular roundings are not suitable. In epicycloidal gearing the addendum of the pinion should then be traced by a rolling circle half the size of the driven wheel.

The conventional method of forming the roots of the teeth of wheels and pinions in watches and house clocks is to carry the radial flanks down to a circle concentric with the pitch circle. It looks pretty, but is not scientific, and makes the teeth unnecessarily weak. The points of the addenda of neither wheel nor pinion can ever go into the re-entrant corners of the spaces, and if the spaces had, instead, curved roots just freeing the tips of the teeth throughout the whole action the fillets left at the roots of the teeth would add immensely to their strength without altering the acting faces at all. In the quick moving wheels and pinions of watches, the pinions are of tempered steel, are long in the head, and the pressures are so light that there is little fear of injury, but in good watches, for many years past, it has been the practice to have curved roots to the great wheel and centre pinion, because, if a mainspring breaks, the violent recoil will strip the teeth from the wheel or pinion, or both, if made in the old-fashioned way. Up-to-date makers are using curved roots throughout the train.

The makers of house clocks, as a rule, have not adopted this sensible plan. Some worthy members of the trade, when shown a wheel and pinion with curved roots, condemned them at once as "utterly wrong, could not work properly," and refused to discuss the question. One gentleman, who admitted that there was no action in these corners, said that they were convenient places for dirt and grit to get into, out of the way. This is a fallacy. They do form convenient places for dirt, which accumulates and hardens until it may stop the clock, but with curved roots there is no resting-place for dirt, and if a piece of grit gets into a space, the first tooth that enters will sweep it out again.

A sector in its simplest form is a proportional gauge, but those used by watch and clock makers have usually the divisions below 20 marked higher up the scale than the true proportionate distances, so that opposite the respective numbers we obtain the corrected measured diameters. As the wheels and pinions in watches and clocks are generally in about the same proportion (7 or 8 to 1), the arrangement is fairly good, but it would not be correct for very different ratios. For a ratio of 12 to 1 the allowance would be insufficient, and the pinion should be larger than the number indicates; for a ratio of 3 or 4 to 1 the allowance would be too much, and the pinion should be smaller than the number indicates.

To obtain uniform lead with toothed wheels certain conditions have to be observed. As each pair has to remain in contact through some definite angle they must intersect. If a pinion has only six leaves, each leaf has to be driven through an angle of 60°; if the pinion has 10 leaves the angle will only be 36°; the less the number of leaves the greater will be the angular intersection, and with pinions having less than 11 leaves contact must commence before the acting points reach the line of centres; with pinions of 6, contact must commence some considerable distance before the line of centres, and semi-circular roundings would not be suitable.

Suppose the acting parts of teeth and leaves were simply radial lines without any roundings to the points, and suppose the driving wheel to be turning round with uniform speed, the follower would move with it, tooth for tooth, but the velocity of the follower from tooth to tooth would not be uniform—the lead would not be uniform.

When contact first commenced before the line of centres the tip of the pinion leaf would be touching the side of the wheel tooth some distance within its circumference, the acting size of the wheel would be too small and that of the pinion too large, the latter would be moving too slowly; when the point of contact reached the line of centres the relative velocities would, for an instant, be correct, but directly afterwards the tip of the wheel tooth would be touching the flank of the leaf deep in the heart of the pinion, the acting size of the wheel would be too large, and that of the pinion much too small, so the latter would then move much too fast; as the contact continued beyond the line of centres the direction of the pinion leaf would become more obliquely inclined to the advancing tooth, and a

point would presently be reached where the tooth would pass down the flank without moving it round at all. The whole motion of the pinion would be irregular, at first slower than it should be, gradually increasing until for an instant it would be right, then suddenly increasing very much and gradually from that point decreasing to nothing.

By suitably rounding off the advancing point of the driver, and the acting part of the follower, we may obtain a constant ratio of angular velocities throughout the whole contact of each tooth.

The fundamental condition to be satisfied by the curves is that the common normal to the curves at their point of contact shall always pass through the pitch point. The pitch point is that point on the line of centres where the pitch circles meet.

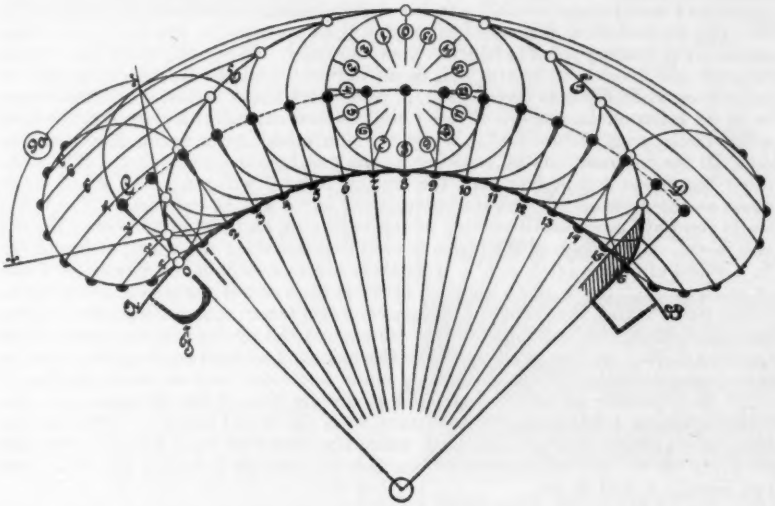


FIG. 13.

EPICYCLOIDAL GEARING.

The forms of teeth used in some machinery, and nearly always in watch and clock work, constitute what is called an epicycloidal gearing.

The acting points of the driver beyond its pitch circle are epicycloids, and the flanks of the follower within its pitch circle are hypocycloids, *both curves being traced by the same rolling circle.*

We imagine a circle to be rolling uniformly outside the pitch circumference of the driver, a point in the circumference of the rolling circle would trace out the curved path called an epicycloid, a rolling circle of the *same size* is then imagined to be rolling inside the pitch circle of the follower, a point in its circumference would trace out the curve called a hypocycloid. When the diameter of the rolling circle is half that of the one *in* which it rolls, the hypocycloid is a radial line. In watch and clock work we almost always have radial flanks to the pinions, so the diameter of the rolling circle used to determine the epicycloidal points of the wheel teeth must then always be half the pitch diameter of the pinion that it drives.

The acting parts of both driver and follower are then of such a form that they follow the path of the circumference of the rolling circle as it rolled uniformly over each of the pitch circles, and the two pitch circles will then move uniformly together.

Trace the epicycloidal addendum of a wheel of sixty teeth driving a pinion of eight, with radial flanks to the leaves, thus :—

$\frac{\text{wheel}}{\text{pinion}} = \frac{60}{8}$, as in this case the rolling circle must be just half the size of the

pitch circle of the pinion $\frac{\text{wheel}}{\text{roller}} = \frac{15}{1}$, and the circumference of the roller will be equal to the length of an arc of 24° of the wheel circle.

Draw the line of centres, draw an arc of the pitch circumference of wheel, outside that draw an arc representing the path of the centre of the rolling circle. If you have taken 7½ inches as the radius of your wheel, then a radius of 8 inches from centre of wheel will trace the path of centre of roller. On either side of the line of centres set out 12° on the circumference of wheel. Through the left-hand extremity of arc draw a radius of the wheel produced to cut the arc of roller path, on this radius draw the roller circle, mark the point, where its circumference just touches the wheel circle, O. Divide the circumference of roller into any convenient number say, 16, of equal parts; number the divisions from 0 to 15 in the same direction as the hands of a watch travel. Divide the arc of 24° into the same number of equal divisions and number them similarly—clockwise, from 0 to 16. Through each of these divisions draw radial lines produced to the centre of rolling circle. The tracing point is to be at 0 on the roller. When the roller has turned through one division its centre will be on radius 1, and the tracing point will be as far from wheel circle as division 1 is, ∴ from point 1 on wheel circle, with distance = 01 on roller circle, cut arc of roller circle struck on radius 1; from point 2 on wheel circle, with distance 02, cut arc of roller struck from radius 2, and so on. Join all the intersections by drawing in one continuous curved line. When the roller has made a complete turn the tracing point 0 will reach the wheel circle again at the division 16, and the epicycloidal curve will be complete. For wheel teeth you only use a small portion of the beginning and end of the curve for the two faces. How much of the curve is used depends upon the width of the tooth. In a wheel of 60 the pitch = 6°; with teeth and spaces equal on pitch line width of tooth = 3° ∴ mark off an angle of 1½° from each end of the curve, the portions of the curve within these angles represent the two faces (brought together to form the complete tooth), and indicate how far beyond the pitch circle the point of the tooth extends. In this particular case the height of addendum is about equal to the width of tooth. When the rolling circle is divided into an even number of parts, the marking of the tracing point is simpler than if the divisions are odd. Thus, divisions 1 and 15 are equi-distant from the wheel circle ∴ Draw an arc from wheel centre through 1 and 15, where the circles on radii 1 and 15 cut this arc gives the 1st and 15th positions, another arc through 2 and 14 gives the next two positions, and so on.

In Figs. 13, 13A, 13B, 13C I am indebted to the drawings of Mr. Otto. Fig. 13 indicates the method of drawing the epicycloid. In this particular case the rolling circle has a radius equal to one-fourth that of the major circle.

The black circles indicate the positions of the centre of the rolling circle at successive stages, the plain circles show the positions of the tracing point at similar stages; the numbered circle at the top shows us that when the roller has performed half its journey the two circles will be in contact on the line 8, and the tracing point will be at the highest point of the curve. During the last half of its journey the tracing point will reproduce an exactly similar curve down to the major circle as it traced upwards during the first half of its roll. The shaded portions show a half tooth of coarse pitch with a high addendum. The space on the extreme right, at B, is formed in the usual way with weak re-entrant angles at the roots of the teeth, that on the left shows a curved root at F which adds strength to the tooth, and it might be much stronger, as suggested by the shading, without danger of the tip of the pinion leaf coming in contact with it.

The arc of 90°, drawn from the tangent to the rolling circle at the tracing point when in position 2, shows the normal to the curve passing through the pitch point on line 2.

In Fig. 13A the hypocycloid is drawn showing that when the roller is half the size of the circle in which it rolls the curve becomes a straight line—the radius of the major circle. The black circles again indicate successive positions of the centre of the rolling circle as it rolls one half of its circumference over one-fourth of the circumference of the major circle, during which time the tracing point will have travelled continuously along a radial line from the point on the circumference whence it started to the centre of the major circle. The tooth or "leaf" is shown

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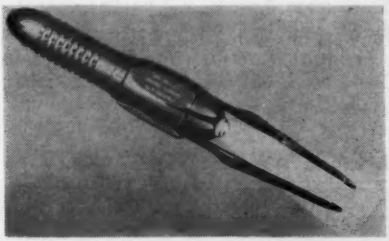

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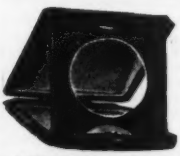

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Shown above is the U.H.A.A. Distinguished Achievement Award presented to W. H. Samelius last September 5, for his outstanding contribution to horology. Mr. Samelius takes this opportunity to express his thanks to all officers and members of U.H.A.A. for the honor, and states that the award will always bring him pleasant memories of the many friends he met during his active years attending guild meetings and conventions thruout the country.

C. P. Martin, Deceased, Was First U.H.A.A. Member In Texas

C. P. Martin of El Paso, Texas, who died last July 13th at the age of 77 years, was the first member of the United Horological Association of America in Texas, holding Card No. 1 since 1935.

Mr. Martin was born March 1, 1877, in Markirk, Alcaase, France. He began his apprenticeship at 14 years of age and worked exclusively in the watch and clock business until his death in an El Paso hospital. He was a resident of El Paso for 39 years and owned and operated Martin's Watch Shop on Texas St. for 37 years. He was a member of the Presbyterian Church, El Paso Odd Fellows Lodge No. 284, and the Watchmakers Guild.

Survivors include two daughters, Mrs. L. T. Shupps and Mrs. C. P. Messing of El Paso; four sons, C. M. Martin of Chicago, R. A. Martin of Nutley, N. J., D. L. Martin of Malibu Beach, Calif., and R. E. Martin of Ft. Worth, Texas. Seven grandchildren and seven great-grandchildren also survive.

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1. The names and addresses of the publisher, editor, managing editor, and business manager are:

Publisher, Roberts Publishing Company, 1901 E. Colfax; Editor, Orville R. Hagans, 1901 E. Colfax; Managing editor, George Martin, 1901 E. Colfax; Business manager, Henry J. Koops, 1901 E. Colfax.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)

Orville R. Hagans, 1901 E. Colfax; Josephine N. Hagans, 1901 E. Colfax.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: **(If there are none, so state.)**

None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semi-weekly, and triweekly newspapers only.)

HENRY J. KOOPS,
Business Manager.

Sworn to and subscribed before me this 1st day of October, 1954.

JOSEPHINE N. HAGANS.

(SEAL)

(My commission expires January 9, 1957)

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